THE

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THE

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ENGLISH, AMERICAN, AND CONTINENTAL STEAM ENGINEERING.

WHEN an engineer like Mr. Philip Dawson writes on steam engines, he is entitled to consideration, but in his article in the *Engineering Magazine*, he first appears to set out somewhat as a special pleader for Americans. We may understand this attitude on this side, but it is rather apt to give false impressions to American readers, who would infer that the award of praise to the products of their own country, implies corresponding blame to the played-out Britisher.

We may at the outset quarrel somewhat with the author in his comparison of the English, American, and Continental engineer. He describes the Englishman as being rarely either a business man or a scientist, but as being a first-rate mechanic. We should rather award the last description to the American, and as to the other two, we are of opinion that any fault in English characteristics arises, not from lack of scientific knowledge in the engineer, but from the lack of engineering knowledge in the business man, who is so jealous of the engineer, and keeps him too much in the background.

The highly trained Continental engineer no doubt does exist, but too often he fails entirely from lack of what, for want of better words, we may call common sense.

When we come to consider steam engineering, we find that there is some truth in the claim that that practice is pretty nearly the same all round, but it is England that has led the way, and America has hardly yet become emancipated from ropes and belts, and the clumsiness of countershafts. Direct coupling was also long delayed among the scientific Continentals, whilst as regards boilers we have yet to see anything either in American or Continental work that can compare with English boiler practice.

The author remarks that the successful high speed engine builders of Great Britain have nearly all been at some time or other connected with marine work, and he describes a few high-speed engines, pointing out the disadvantage of bulk attendant on single-acting engines. He names, also, the Universal engine, the double-acting Belliss engine, the recent Maybank station engines of Browett & Lindley, and those at Liverpool on the overhead railway; the latter are of 1,500 H.P. This type of engine has a piston valve placed between the two cylinders of a compound engine. It has fly-wheel governors, and runs at a high speed with very little noise.

An interesting diagram is given which shows power and speed curves for three well-known high-speed engines, and a mean curve is drawn which shows how very similar high-speed engines have become. Very little construction in the way of large slow-running engines has been done in England. The engines at Deptford were built by a firm of factory engineers, who also undertook to build, and did partly build, a set of 10,000 H.P. Where American

influence has been brought to bear, we have seen the retrogresssion to the low-speed engine.

We ourselves think that far too much bogey has been made out of the demands of traction work. Fearful stresses have been invoked by Americans to frighten engine buyers into the belief that only American engines were suited for such work. Yet in spite of all this terrorising the American engine as sent over here is not in any way designed, as a rule, as though such stresses existed. So much has been unfairly charged by Americans in their anxiety to capture business in England, that it has stirred up people, who otherwise would have been silent, into criticism of some of the American designs. One expert severely criticises the crankshafts of the Glasgow engines, with their jointed crank pins, cantilever thrusts, and overhung pressures, their bored guides and the faulty arrangement of bearings for the dynamo and fly-wheel. These matters are, of course, to some extent a matter of opinion, but it has always seemed to us that in this design of crankshaft an enormous frictional loss was caused, for which no advantage could be shown.

When an engineer of Mr. Dawson's ability takes up the question of steam engines, he is able to show (what people are apt to forget in the loud shouting for American claimants) that the British makers have all the time been going steadily forward, and have not been content to follow the beaten track along which American practice has struggled over its wreckage of jack shafting and multitudinous belting. The British engineer has evolved new types suited to the work they are required for, and the scientific Continentals and Americans are not yet up to the point where they can successfully follow despised Britain.

We do not think that throttle governing is throughout superior to variable cut-off governing, as Mr. Dawson claims it to be, and in this we think we are in agreement with many others who consider throttle governing to be rather applicable to those light loads that should, if possible, be avoided. We cannot, of course, avoid all light loads; power stations must inevitably have much light loading, unless provided with accumulators. We would not carry variable expansion to the extent it was once carried in American practice, through the error of supposing that the benefit that followed the adoption of the Corliss valve was due to variable expansion rather than to separate exhaust valves and good cylinder drainage. The variable expansion craze was carried too far at home also, notably by the Lancashire engineers, who applied automatic expansion to engines whose load was a dead level the year through, and who in many cases applied the automatic variability to the low pressure cylinder also — an example of the absurd lengths to which ideas, correct enough within moderate limits, are often carried. We have noticed a tendency among steam-engine makers to decry that system of governing for which their particular engine was least suited.

Motor Car Construction.

A SERIES of interesting articles by W. A. Th. Muller, on the solution of the problem of the electric motor car, has just been concluded in the *Centralblatt für Accumulatoren und Elementenkunde* of October 1st. Herr Muller has estimated the losses due not only to friction resistances, but also to dynamical disturbances, such as shock, and the oscillation of the body of the carriage on its springs. The following are his conclusions as to the fundamental principles of motor car construction:— (1) The wheels should be of large diameter; (2) the wheels and their axles should be light, and should be as free as possible from the other parts of the vehicle; (3) the carriage springs should be made so as to give a large deflection with a small change of load; (4) The upper body of the carriage, with all its attachments, should form one rigidly connected mass. These principles can only be partly observed in practice, some of them being, indeed, contradictory; for example, a large wheel cannot be at the same time a light one, and in such cases the best *via media* must be found. According to the second and fourth rules, all parts of the driving mechanism must be free from rigid connection with the axles, but should be rigidly connected to the body of the vehicle. Chain driving gear or some gear allowing free relative movement of the body and undercarriage becomes thus a necessity; toothed gearing being inapplicable. The lightness of the springs is limited by the strength necessary to carry the load without injury. The fourth rule indicates that the practice, which is sometimes adopted, of mounting the batteries on springs inside the body of the carriage, is not a good one.

Motor Cars and the Law.

FROM every quarter legal difficulties which check the legitimate aspirations of motor car proprietors, appear to spring up; so much so that the headline "Stifling an Industry," which occasionally adorns the columns of some of our daily contemporaries, seems to bear the stamp of truth. The speed of motor cars on highways has been the subject of many prosecutions in police courts during the last few months. These prosecutions have nearly always been successful, and, in the great majority of cases, the opinion of a constable as to the speed of the car in question has brought conviction to the minds of those on the Bench, and has consequently secured the conviction of the motor car driver. "Robert" standing at the street corner with a watch (which probably goes when it is carried) is the first, last, and only tribunal for the determination of the velocity of motor vehicles. While there can be no question that some owners of motors fly along the highway utterly regardless of the comfort of liege subjects who are more old-fashioned, there seems to be a lack of discrimination in the way in which fines are inflicted. The magistrates, in convicting wholesale, seem to disregard (1) the question whether the district is crowded or not; (2) the time of day; (3) the extraordinary ease with which the motor can be pulled up; (4) the evidence of the driver, who, in the nature of things, is probably the best judge of the speed of his own carriage. It can, of course, be argued that the statute says speed must not exceed a certain maximum; but the fact that law is to be administered according to strict rules of evidence is sometimes lost sight of. Moreover, in these matters, the opinion of the "beaks" is practically final. We must only hope that when motors are the rule rather than the exception, the just consideration of the above questions may lessen the number of convictions. As might be expected, local authorities are endeavouring to have their finger in the motor pie. In the recent case of Godfrey *v.* Napier, which came before the Divisional Court on October 8th, a London County Council inspector had summoned a motor car manufacturer for keeping a quantity of petroleum otherwise than in pursuance of bye-laws made by the local authority. It appears that under the Explosives Act of 1871, no one could keep petroleum except under license from the local authority. Fortunately for the motor industry, the Act of 1896 provided that the keeping of petroleum should be subject to regulations of the Secretary of State, which were to have effect notwithstanding the provisions of the Explosives Act. In spite of this, the London County Council, to use the words of the Chief Justice, "made an attempt to substitute their own regulations for those of the Secretary of State." The magistrate naturally refused to convict, and the Divisional Court, for equally obvious reasons, affirmed his decision.

Gas Producers and Electric Supply.

Commenting, in the *Mechanical World*, on gas producers and engines, Mr. W. H. Sisson points out that, whereas a 50 H.P. steam engine will use 3 to 5 lbs. of coal per B.H.P.-hour, a gas engine is guaranteed to give power at a rate of only 1 lb. of anthracite per B.H.P.-hour. Why, then, does not everyone use the gas power, and why have Coatbridge, Leyton, and King's Lynn, rejected gas for steam? At Coatbridge, he says, the current is alternating, and alternators cannot be run with engines having one impulse in four strokes; if a single explosion is missed the alternators are at once out of step. Obviously in the present state of gas engine knowledge, alternators can only be driven suitably by more than one engine, if the foregoing be true, and they must not be run on the hit-and-miss principle, but on the principle of reduced charges—a matter of no serious importance with producer gas. Mr. Sisson refers to the clinkering of the producer; this, he says, will occur in two hours with inferior anthracites, and since the clinker forms not on the bars, but on the top of the fuel like a pie-crust, all the fuel below must be raked out to get out this crust, and the raked-out fuel cannot again be used in a producer, though it will burn in a boiler furnace; all of which adds enormously to the fuel consumption of the gas engine. Complaint is also made of the quality of the gas, which varies so much that an engine will drop 10 per cent. in power in five minutes after firing a fresh 10 minutes' charge. This, we take it, is rather an argument for large producers, which are much steadier than small ones in the quality of their output. The complaint as to insufficient fly-wheels is soon remedied. Bursting of ignition tubes, it is true, may shut down an engine, but what is the matter with electrical ignition? It is admitted that stand-by expenses and repairs are less, and that, starting up from the cold, 100 H.P. can be had in an hour. Producers will stand overloading heavily, but clinker-up all the faster. As to starting the engine, he advises the use of the dynamo as a motor, by means of accumulators; this is undoubtedly the proper system. Such generally is the criticism of an engineer on the gas engine for electric work. We do not doubt that the producer makers will have a good answer to the objections. Undoubtedly the gas engine, though a better thermo-dynamic machine than the steam engine, is yet behind it as a running machine, but it is too cheap a motor not to be awarded every attention, and it will ultimately become a better machine than it is to-day.

Magnetic Effect of a Moving Electric Charge.

Modern electric theory assumes that a static charge in motion will create a magnetic field similar to that produced by an electric current. Several attempts have been made to get experimental proof of this hypothesis, but the results have been somewhat contradictory. Rowland and Hutchison, in 1889, by a series of careful experiments, appeared to have obtained the required proof. But last year, M. V. Crémieu, in Paris, made experiments on this subject which appeared to him to show that there was no magnetic field created by a moving charge, and he came to the conclusion that the results obtained by his predecessors must be erroneous. Quite recently Mr. A. P. Adams has carried out an experiment, which supports the results obtained by Rowland. The apparatus of Adams consisted of 16 copper balls of 2·54 cm. diameter, which were arranged in a circle of 20 cm. upon an axis. From 2,700 to 4,000 r.p.m. could be imparted to the axis, so that the circumferential velocity of the balls was from 50 to 80 m. per second. Each of the 16 balls was, by means of a storage battery of 10,000 cells, raised to a potential of 19,000 volts, equal to 63 C.G.S. units. Since the capacity of a ball was 1·27, the quantity of electricity on each ball was 80 C.G.S. units, or $2{\cdot}67 \times 10^{-8}$ coulomb. The equivalent current value was therefore

$$\frac{2{\cdot}67 \times 16 \times 4{,}000}{60 \times 10^{-9}} = 284 \times 10^{-7} \text{ amperes,}$$

or 284 microamperes.

To obtain a definite distribution of the electric field, a similar set of balls was set in motion in the neighbourhood of the first apparatus. A very sensitive set of astatic magnetic needles showed a distinct deflection under the influence of the rotating balls.

SOME EXPERIMENTS ON THE WEHNELT INTERRUPTER.

By M. A. CODD.

The following experiments were performed with the idea of inquiring more closely than had hitherto been done, into the working of the electrolytic interrupter.

It was found that by using two breaks in series the spark length could be increased, especially with certain coils having a comparatively high self-induction. In some cases the spark length may be doubled, and the current in the primary considerably diminished.

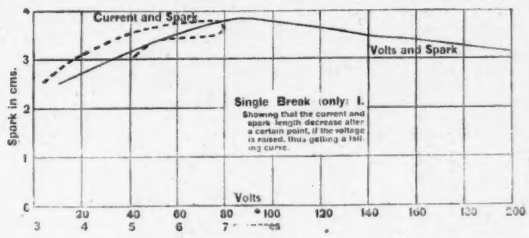


Fig. 1.

The spark obtained from the secondary is not so heavy as that obtained by the use of a single break, yet is sufficiently heavy to work a Crookes tube, in the way that an ordinary single Wehnelt break would work it, when using a larger coil.

If we take a coil of ordinary self-induction (with, say, three layers of primary) in series with a single break, and vary the voltage from 0 to 200, we find that after a certain voltage has been reached, generally at about 100 volts (see figs. 1 and 2), the *current* and *spark length decrease* with an *increase of voltage.*

If now the same coil be worked with two breaks in series, it will be found that the spark length and current increase nearly proportionally with the voltage (see figs. 4 and 5).

While using a 12-in. coil having three layers of primary on the 200-volt main, I obtained a 6½-in. Wehnelt spark

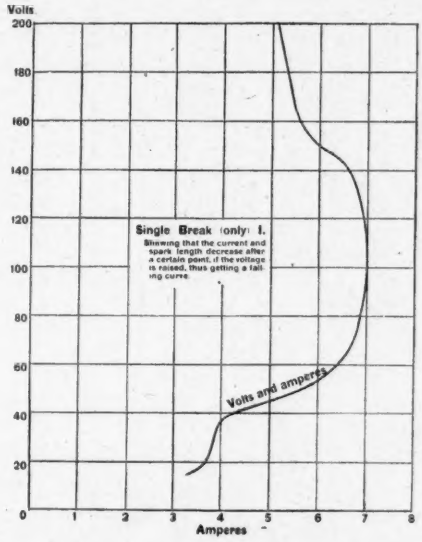


Fig. 2.

with 8 amperes, having one break in series with the coil. Using two breaks in series, a 12-in. spark was obtained with the same current. With a coil having two layers of primary, the effect is not quite so marked, and with a single layer is not perceptible.

It will be noticed from the curves that the effect of the two breaks in series is not so marked at comparatively low voltages.

From the above it will be seen that if a coil is being made for a single Wehnelt break, not more than two layers should

be used; one layer may be better still if the coil is of a moderate size, having about 10 lbs. of secondary.

Two breaks in parallel will work synchronously and in step, so that the current passing through the primary is double the current passing through one break only.

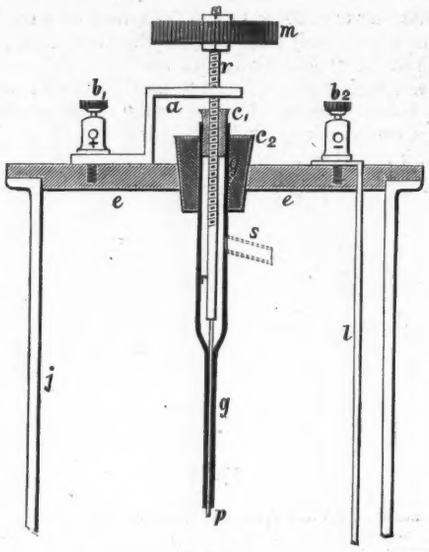


Fig. 3.

Any number of breaks will work in step if needed, the conditions being that each platinum surface exposed must carry the same current, *i.e.*, with equal strengths of acids equal surfaces must be exposed.

If these conditions are fulfilled, the frequency remains the same as if only one break were used. Thus the current may be increased and the frequency remain fixed, which could not be done if one large anode were used without raising the applied voltage.

By having several of these fixed anodes in the same vessel, and using a multiple-way switch, an adjustable break can be made.

It was previously known that when the electrolyte became warm the interrupter ceased to work, or "fatigued." Some thought this fatigue to be owing to some change other than heating.

The following experiments have shown that fatigue is due to heating only, and that the limiting temperature is within one or two degrees of 75° C.:—

The break was set up to work well and then heated by a flame. Every few degrees the break was tried, and it was found that at 75° C. it stopped working well.

The break was now allowed to heat itself, and at 75° C. it would no longer work properly.

When the break was water-jacketed it worked well as long as the current was on.

The gas which was given off from the platinum anode was caught and analysed. It gave the following result:—Hydrogen, 60·5 per cent.; oxygen, 39·5 per cent.

The action of the break is probably as follows:—

The platinum point becomes red hot owing to its small surface, and converts the electrolyte into steam (oxygen and hydrogen).

This layer of steam insulates the anode; the circuit is now broken, but the extra current from the coil flows back and ignites the mixture of oxygen and hydrogen, which explodes, giving the well-known humming sound which always accompanies the working of the Wehnelt break. After the explosion the anode touches the electrolyte and the circuit is again closed.

Condensers shunted across the secondary spark gap give a remarkable effect; the spark is an intensely vivid blue, entirely different from either the Wehnelt or the ordinary spark.

The condensers must be of the right capacity or the spark breaks up into the Wehnelt flame. If a condenser of sufficient capacity be shunted over the break or coil, or both, it causes the break to stop working, and the platinum point merely becomes red hot; and if the condenser be removed the break does not restart.

If a choking or self-induction coil be placed in series with the break and coil, and the latter has a rather high self-induction, it is a disadvantage; but if the coil has too low a self-induction it is an advantage. The amount of additional self-induction required depends on the current passing, the frequency, and the voltage.

As the voltage rises, the frequency also rises. A coil should only have one or two layers of primary, but each coil has to be tried experimentally to get the best results.

If the primary cannot be changed when the coil has too high a self-induction, it is best to use two breaks in series.

As the frequency increases with the voltage, it was thought that if the voltage was raised sufficiently high, the break would be noiseless. At 300 volts the frequency was still rising, and at 400 volts the break emitted a very shrill note. Up to the present I have not been able to work with a higher voltage.

It is noticeable that at these high frequencies produced by the break, the iron wires in the core get very hot, even when not bigger than No. 22, and coils for the acid break should

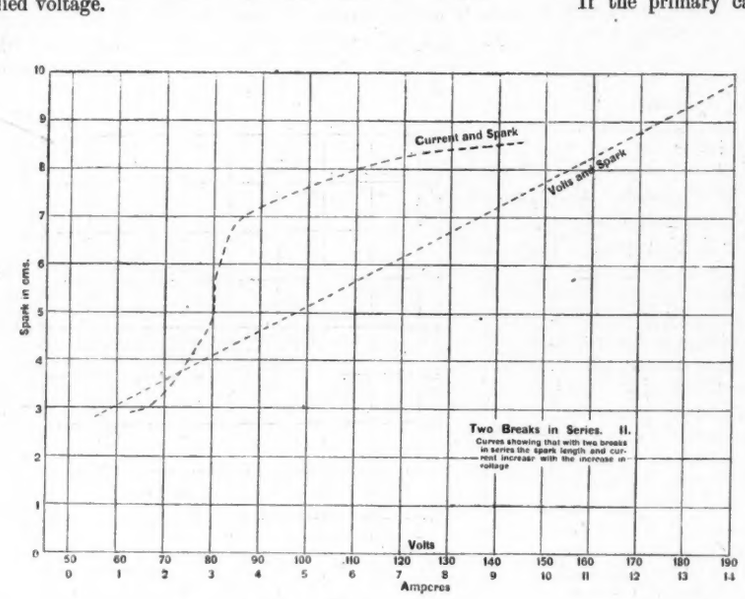

Spark in cms.
Current and Spark
Volts and Spark
Two Breaks in Series. II.
Curves showing that with two breaks in series the spark length and current increase with the increase in voltage
Volts
Amperes

Fig. 4.

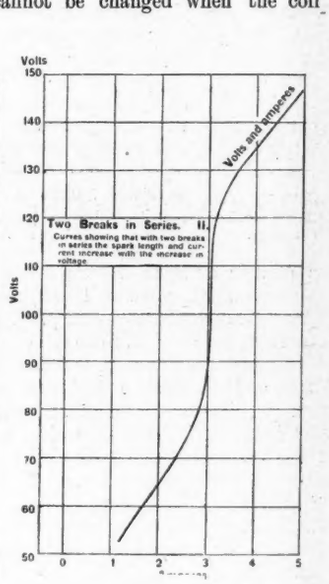

Volts
Volts and amperes
Two Breaks in Series. II.
Curves showing that with two breaks in series the spark length and current increase with the increase in voltage
Volts

Fig. 5.

have cores of No. 30 wire. It is easily possible to heat a bundle of No. 22 wire to a blue heat.

The ordinary continuous and alternating current ammeters are absolutely useless for measuring the current passing. I had three different ammeters in series, and their simultaneous readings were 5, 10 and 15 amperes respectively. The only reliable instruments for this purpose are hot wire ammeters on the Cardew, or the Hartmann & Braun principle.

Anodes of iron, copper, lead, carbon and aluminium (the above are in order of merit) were tried, but all wore away too quickly to be of any practical value.

The first type of break experimented with was the original sealed-in platinum wire. This soon failed to act, because the mercury was absorbed by the platinum, forming an alloy which was quickly eroded by the action of the interrupter; the glass, too, was soon cracked.

Tubes with tips made of various materials of the nature of fibre, ebonite, mica, vulcanite, wood, india-rubber, &c., were tried, but were almost at once burnt away by the flame round the platinum wire. The best glass for the sealed-in type seems to be Powell's.

The reaction of the acid against the platinum wire and glass point is very great, and if a sealed-in break with two points on arms, on the principle of the "electrical whirl," be constructed, the whole break will go round and round in the acid.

The break with which these experiments were conducted, and which proved to be the most reliable and satisfactory, is shown in fig. 3. P is a platinum wire sliding in a fine glass tube g, with parallel sides. The top of the platinum wire is fastened to a brass rod r, its upper half working through a gas-tight cork c_1.

At the top of the brass rod is a milled ebonite head m; by turning this the rod (which has a thread cut on it) is raised or lowered, and consequently more or less platinum is exposed.

In a later form, the rod, r, is made to slide up and down, instead of being raised and lowered by a screw. The glass tube wears away very slowly, and to overcome this, it is only necessary to back the platinum wire a little. The whole is supported by a rubber stopper c_2 on an ebonite lid e; j is a glass jar, l the cathode, b_1 and b_2 the terminals, and a a rubbing contact.

The intense reaction of the acid against the platinum point caused the liquid to rise in the glass tube, whence it was allowed to escape again by a spout s. This is how it is arranged in Siemens & Halske's form of interrupter, and also in Caldwell's.

I found, however, that the stream of electrolyte issuing from the spout was sufficient to short-circuit the electrodes, and produce a minute spark at the surface of the electrolyte, sufficient to ignite the gases in the vessel and cause an explosion. The spout was therefore got rid of, and the cork at the top of the glass tube made a good fit. The rising liquid now compressed the air in the tube, which prevented its rising further. This was found quite satisfactory, and required no adjustment for days together.

There is no doubt that a good electrolytic interrupter working a coil is unsurpassed for many purposes, but particularly for lighting Crookes tubes.

There is no danger of burning the tubes out if suitably strengthened ones are used, while the great gain in the unflickering steadiness of the tube more than counterbalances any small defects which may occur through unskilled manipulation of the break.

An X-ray tube worked by the Wehnelt break gives very brilliant screen effects, and greatly reduces the time given for photographic exposure. Might not its use in the treatment of lupus, &c., also decrease the time of exposure? If this could be done, it would mean a corresponding increase in the number of patients treated in a given time.

The Wehnelt discharge is also suitable for the production of ozone, working ignition coils of stationary gas engines, and for many other purposes.

WIRELESS TELEGRAPHIC INSTALLATION IN H.M. SHIPS.

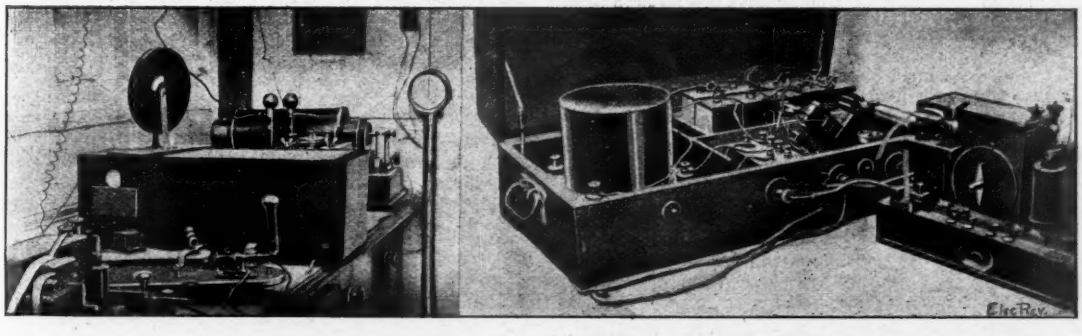
[COMMUNICATED.]

The Admiralty some time ago decided to supply wireless telegraphic apparatus to all the battleships in the Mediterranean Squadron, and most of the cruisers. There are a good many sets of the apparatus now in use on that station, and we give a couple of illustrations showing the manner in which the instruments are set up.

Those who are not familiar with these instruments, will be able to gain some idea of the general arrangement by studying the two photographs.

The first thing that is necessary before setting up the operating table is to choose some suitable place, such as a spare cabin or chart house, through which the aerial wire may be led without risk of its sparking through to earth.

In the case of a chart house or signal house on the upper deck this is, of course, easy enough to prevent, but when it becomes necessary to lead the aerial wire through the deck there is need for very thick insulation; the method most in vogue is to cut a hole of a diameter of about 4 or 5 in. through the deck plates, lining it with a half-inch ebonite tube. This tube stands up from the deck to the height of 16 in., and is sheathed from the wooden planking upwards with brass to protect it from injury; it is capped with a thick disc of ebonite. The aerial wire is led through this after being well insulated with india-rubber and oiled silk, the insulation gradually tapering off as it leaves the tube in such a manner as to give the impression from which it has earned the name of "cow's tail." The space between the insulation and the ebonite tube is filled with melted paraffin wax.



Wireless Telegraphic Apparatus in H.M. Ships.

The "cow's tail" having been made and fitted, the aerial wire is measured off to the required length and led through large plates of ebonite to a spar projecting far enough outboard to give the wire a clear lead up to the spar at the masthead. The use of both these spars is chiefly to keep the aerial wire clear of wire rigging or ropes, which, in damp weather, would make "earth." Ebonite insulators protect the aerial wire from contact with the spars.

In many ships the wire is looped so that the end turns back upon itself, and is spliced to its own part close to the outrigger spar, the object being, of course, to obtain greater capacity for the same height.

So much for the aerial wire; we now turn to the other end of the "cow's tail," which is led into the operating room, and may be seen in the photograph slanting from left to right, and joined up to one of the brass balls of the induction coil. The other ball of the coil is joined to earth by means of the vertical wire coiled in a spiral, where it is soldered to one of the iron beams.

A much thinner wire will be noticed coiled into a spiral form, and also coming from the "cow's tail." This is the receiving lead from the aerial wire, and comes down to the keyboard which is seen behind the Morse inker.

Between the coil and the keyboard is seen the receiving box, which we shall presently examine in detail and with the aid of the second photograph.

Seven accumulators are generally used to work the coil, and the keyboard shows where the negative wire is brought to the signalling key.

The key is grasped by the long ebonite handle, and a succession of longs and shorts made with it is reproduced in sparks between the two brass balls connected with the aerial wire and earth respectively, setting up oscillating currents in the wire and thus sending out the so-called Hertzian waves.

In the photograph a small block with a hole in it may be noticed immediately below the white disc on the receiving box. This block is made of ebonite, and is intended to receive a small spur on a long arm that extends from the signalling key.

It is this arm which switches the aerial to "send" or "receive." It is shown in the "receive" position, in which case the thin spiral wire from the "cow's tail" is put in connection with the receiving box; if, however, the arm were swung over to "send," the whole receiving box would be cut out of circuit with the aerial wire.

We shall now consider the receiving circuit and trace the current from the thin spiral wire.

The second photograph shows the receiving box open, with a Morse inker beside it.

The receiving box is covered with a brass sheath, the object of which is to intercept any local electro-magnetic waves that might proceed from sparks in the neighbourhood and directly affect the coherer, rendering messages unintelligible. Hence it will be seen that the box is kept shut when in use.

The lead from the aerial wire, coming from behind the Morse inker, enters the box and picks up the primary of the "jigger" underneath the little group of terminals; this jigger is earthed through the box. The secondary of the jigger is divided into two coils, its two outer ends being brought to the two outer terminals of the row of four that is seen. These outer terminals are connected to the coherer, while the two inner ones, representing the two inner ends of the primary, lead through choking coils, one to the relay direct, as seen, and the other through one of the cells of the battery of "Obachs" at the back, and so to the relay.

The relay is enclosed in the cylindrical case on the left. In the photograph no choking coils are visible, because these are enclosed in the box which contains the jigger, below the group of terminals. The outer terminals, as we have seen, are joined to the coherer, which may be recognised above the inclined electro-magnets which control the "tapper."

The two large terminals on the left of the relay belong to the local battery circuit. This battery consists of the remaining nine cells—or, rather, eight cells, for one is usually kept as spare. The connections of the local battery are tucked away out of sight, but it will be sufficient to say that the Morse inker, alarm bell and tapper are forked into it.

Shunt coils, of which one is just visible in the right-hand corner of the box, are put into the tapper circuit to prevent sparking at make and break. We have yet two terminals of the group above the jigger to account for; these are the two with wires dipping down into the interior of the box; they are the ends of the primary of the jigger to which the aerial wire is connected.

The operating table is covered with sheet india-rubber, and the whole apparatus can comfortably be worked in a space of about 4 ft. × 2 ft. A common dodge for testing the sensitiveness of the relay consists in slightly moistening the fingers, and touching the two centre terminals of the group, when the tapper should buzz. Should the relay be too sensitive, the single cell will have power enough to keep the tapper in vibration after it has once started, and this must be carefully guarded against; it is one of the most difficult adjustments to be made, and once obtained, should not be altered unless absolutely necessary; a continued buzzing of the tapper often shows a defective coherer, *i.e.*, one which offers too little resistance in its decohered state. Many coherers are supplied, and they are easily exchanged.

Signals, of course, can be taken in by simply listening to the working of the tapper; it works exactly with the tongue of the relay and consequently with the inker.

Signals must be made slowly; it is possible to make a "short" so short that the tongue of the relay has not time to go over, and consequently no record is made.

The whole apparatus can be fitted up in a ship in a very short time—one forenoon may suffice—but the adjustments often take a long time to get in order, and there are so many possible causes of faults that it generally pays to do everything in "slow time."

With the apparatus shown, signals have been received at a distance of 120 miles.

A COMBINED CABLE AND TROLLEY SYSTEM.

Amongst its many admirable features, our excellent contemporary, *Cassier's Magazine*, sometimes offers to its readers useful mental exercise in the shape of an all too brief account of some new development, presenting very considerable interest to technical readers, if only they were told a little more about it than can be gathered from about one page of description, combined with over three pages of pictures.

A ratio of the latter kind makes it necessary for the engineer who is interested in the matter, to puzzle out for himself most of the details, and perhaps the preparation and training for new conditions thus involved does him more good than a full description, so long, of course, as he imagines the ins and outs of the thing after a workmanlike fashion.

An instance of this may be seen in the description of a combined electric trolley and cable system which may be noted in a recent issue of *Cassier's*. The line in question forms part of the tramway system of Palermo, where a circular urban tramway has radiating branches into the suburbs; and although the distance involved is not very great—only about 2 miles or so—it is filled with very much of interest to the electric traction engineer.

A heavy grade has to be surmounted (ratio not stated; but as it appears to be too heavy for ordinary adhesion working, it doubtless exceeds 1 in 8, or 1 in 10), and this is done by means of auxiliary motor cars, two in number, and one at each end of a cable or wire rope stretched along the grade.

The first length of line up to the grade is fairly level, and about half a mile long; then on the grade itself—about 1,200 yards in length—the track is double, with one rail common to both lines, and with a halfway turn-out. In between the rails of each track are laid other rails to a narrow gauge, on which the auxiliary motors run.

The object of this arrangement is to allow the auxiliaries (which, of course, go up the grade behind the electric cars, and come down in front of them) to drop at the bottom of the grade into specially formed and graded pits or pockets, so as to leave the main tracks quite free for an electric car to pass over the auxiliary.

From the top of the grade there is another fairly level stretch of single track, about half a mile long, to the terminus of the line. The line throughout appears to run on its own land, and is therefore more of a railway than a tramway.

As the auxiliaries must leave the top and bottom of the grade respectively at the same time, the electric cars must also be timed to reach these points as nearly simultaneously as possible, so as to avoid delay, and the weight of the descending electric car and auxiliary acting on the cable is thus usefully employed in helping to pull up the ascending car and auxiliary attached to the other end of the cable.

The auxiliaries appear to be provided with electric motor equipments, and the entire line (grade included) has the trolley wire in position, so that the ascending train is not only helped up by the descending train as stated, but may make up the balance of power required to surmount the grade by using its own motors, so far as their driving wheel adhesion is available.

Just how far it may be altogether advisable or safe to venture on working the grade in this way, with possible danger of over-running the rope, may be left to experience to show; the same objections would not apply to the descending train, and one would feel inclined to say that the whole responsibility of working such an incline should be entrusted to the descending train, whose speed of descent should govern absolutely the ascending car speed.

There would (even with a crowded descending car and a light ascending one) probably be considerable power required to work the incline, to overcome rope and wheel friction, &c.; and this power should preferably be exerted by the descending rather than the ascending train.

Both auxiliaries are said to be provided with powerful track brakes.

The working out of this line has been done by the Schuckert Company's engineers, from Nuremburg; and its successful installation and operation may serve to show that the popular idea of Sicily, as a land of brigands and deadly feuds, even if correct, does not appear to be incompatible with more progress and development in other directions than can be seen in other countries boasting of what is considered a higher civilisation.

EFFICIENCY OF PRODUCTION.

By N. C. WOODFIN.

Assuming that there is a market for his commodities, the efficiency of production is the factor that chiefly determines a manufacturer's success. For it is this which fixes the cost of an article, and ultimately it is price that causes a buyer to select one thing in preference to another, it being only necessary for the articles to be of approximately equal excellence for the purpose required.

While this state of affairs may be an ethical misfortune, and but a phase in the progress of civilisation, it is the commercial fact of the present.

In electrical appliances, perhaps, efficiency of production is principally promoted by economy in labour and design. While excellence of design may go a long way in reducing cost, it may be completely checkmated by extravagant labour; this latter is always the result of lack of organisation by management, and of untrained and rambling intelligence on the part of the workman. Thus mediocre design may compete successfully with genius, where the former is the production of the most intelligent and systematic labour, and the latter is handicapped by obsolete and uneconomical methods of working. Really excellent design is only the product of great intuition, combined with large and diversified experience. It is therefore exceptional. Economy in labour is accordingly the controlling factor of production for successful competition in market price.

This labour result is affected by organisation in many ways; the axiom to be followed is: given the articles to be made, everything must be so arranged as to avoid unnecessary handling. This, of course, means system and order; the simple rule, "a place for everything, and everything in its place," must hold. Work must take its turn, and it is for managers to determine how far it is profitable, actually or possibly, to disarrange order so that the wishes and desires of any very urgent customer may be complied with. Organisation also settles responsibility, it being manifestly most important that the right person may be judged for any fault. Nevertheless, it may be questioned whether or not, after all, mere labour itself does not decide the issue, because the greater the intelligence and rectitude of labour, the greater is the speed of production, with, at the same time, the advantage of lessening expensive supervision. The conditions which bring this are harmony and goodwill between master and man; how Utopian that seems to-day sometimes! To be practical, however, enmity must give place to amity, competition to co-operation, and, in intelligent and well-ordered labour co-partnership, is found that harmonising of interests essential to economy.

Space, light, health and air, and reasonable comfort in work, are being increasingly recognised as not only just, but directly profitable, because of the increased efficiency and resulting economy in labour. It may well be asked again whether or no advantages in these directions would not make it worth while for more works to remove from the large towns into the country. Judicious selection of site alongside of waterway and railway will go far to annul distance from markets, lest more costly transport should counterbalance the reduction in selling price obtained by increasing the efficiency of production in the ways suggested.

THE UNDERGROUND RAILWAY ELECTRICAL INQUIRY.

(*Continued from page* 746.)

On Tuesday last week Mr. Lyttleton sat again, and Mr. Cripps opened the case for the Metropolitan Company, and remarked that it was sufficiently obvious that there would be nice points of electrical science and electrical working on which there was a considerable conflict of evidence. He did not shrink from the tests which had been set forth by Mr. Fletcher Moulton, viz., safety, efficiency and cost. He would meet each point and would claim that on every head he had the advantage. They claimed the same advantages for the polyphase system that were claimed by Mr. F. Moulton for the direct system. The Metropolitan Company had no hostility to the District Company, and the Joint Committee of the two companies came to an arrangement so that tenders on the polyphase system were asked for, and this system would undoubtedly have been adopted had it not been for the intervention of Mr. Perks and Mr. Yerkes. With regard to the question of this being an untried system, he thought it could not be urged to the disadvantage of the Metropolitan Company that the District Railway was in a difficult position financially. Going into the history of the negotiations between the Metropolitan and the District Railways, he pointed out that a Joint Committee of the directors of the two companies were appointed to consider what must be described as a complex problem. The Committee appointed two eminent electricians, viz., Sir Wm. Preece and Mr. Parker, to try and solve the problem, and they came to the conclusion that the polyphase system was the best. Mr. Fletcher Moulton tried to show that certain mistakes were made by Sir W. Preece and Mr. Parker, and that on the question of cost they were mistaken on one or two crucial points. The first report of these engineers was on the tenders, and Mr. Fletcher Moulton had criticised that. His (Mr. Cripps) view of the matter was that the real problem was the probable cost of equipment and working of the two systems, having regard to the traffic with which they had to deal. The tenders were not issued on that basis, but were issued to meet the requirements of the engineers. He contended that the criticism which Sir W. Preece and Mr. Parker made on the tenders was absolutely correct, and that Messrs. Ganz's tender stood out above all others in price. As regarded price, by the polyphase system they got great advantages, and as regarded power they got some advantage. The substantial difference between the two systems was that they had less of the human element in the polyphase system; they got rid of the human element as far as possible, and he thought it was much better to have what he might term automatic working than the fallible human element.

The Arbitrator asked in what points was the human element eliminated.

Mr. Cripps said that it was where they got the 10,000 voltage transformed to 3,000, and then the 3,000 went to the motor. In their system there was no human element in that, but with the continuous system they must have a person to manage the rotary converter and the switchboard. In connection with the rotary converters, supervisors were required by the Board of Trade to work the continuous current, whereas, in his case, the whole thing was automatic. As to the Messrs. Ganz's system being in an experimental stage, Mr. Fletcher Moulton had much exaggerated that. Sir W. Preece and Mr. Parker went out and saw the system practically demonstrated; they made a careful report on February 7th, 1901, and said the reason why the three-phase system had not been extensively used in England was that the use required two insulated conductors, which were objectionable in the streets. Mr. Swinburne himself, who was well known for the impartiality with which he

gave evidence on all these electrical points, practically withdrew what he said about the inefficiency of the three-phase system after what was put to him by himself. With regard to the transformation of high voltage to lower voltage, this was no more difficult in the case of traction than in the case of electric lighting. He had no doubt that the Arbitrator remembered the inquiry into the lighting scheme of the Metropolitan Electric Supply Company, where the idea was to erect generating stations outside London and bring the current at a high voltage to a district and then transform it.

The Arbitrator: We asked Lord Kelvin if it was not a huge experiment.

Mr. Cripps said that was so, but it was now he supposed the accepted system with regard to lighting. The problem electrically was no more difficult in one case than the other, although as regarded safety he admitted that was a different question which he would have to deal with. He admitted that with regard to margin of speed they had a greater margin with the continuous system, but he submitted that having regard to all the conditions of traffic, there was no advantage with the continuous current motor. Mr. Cripps proceeded to trace the history of the consultations of the Joint Committee of the two companies, and pointed out that the disturbing elements were Mr. Perks and the Board of Trade. Mr. Perks had made up his mind to have the continuous system and he attached to himself some American friends and obtained an absolutely controlling influence over the District Railway. They must have known that the Joint Committee was meeting, but they stopped the whole thing as far as the District Company was concerned, and said they would have nothing on the District Railway but the continuous current system. It was not a question with them which was the best, but they were committed to it by tradition and policy. Then the friction arose, for the arrangement between the Traction Company and the District Company was such that there could be no impartial consideration of the two systems.

The Arbitrator said he took it that the real point of Mr. Cripps was that seeing the close agreement which existed between the two boards as late as June 13th the Metropolitan Company had no course open other than to give a trial to the Ganz system.

Mr. Cripps said it was a little more than that. He thought there was much more weight in the consideration of two boards with expert advice and their determination of the question before them than when they got two sides criticising one another's system. He did not care how perfect any system might be, an antagonist would be able to get experts to throw doubts upon it. He put it that if Mr. Swinburne had approached the system from the point of view of solving the difficulties instead of criticising, he would have found no difficulty in solving the difficulties. They were told that the Traction Company were to stand the risk in the future, but they were to get a clear 5 per cent. before the debentures. Then they took £16€,000 4 per cent. debenture stock, and the debenture stock of the company stood at 96. There might be some risk in the £500,000 ordinary stock they took. He failed to see where the philanthropy of the Traction Company came in.

The Arbitrator said he took it that these observations were directed to the cost.

Mr. Cripps said they were directed to this point, that when they had two companies acting under independent advice agreeing upon a course and they saw it suddenly upset, they looked to see why it was upset, and in this case he submitted that it was not upset on any scientific point. Proceeding to deal with the electrical part of the case, he thought there was abundant evidence that the three-phase system could be thoroughly trusted from a practical as well as a scientific point of view. The first point raised was that of safety. In the continuous current the danger was the accessibility of the contact wires, and the workpeople were constantly passing along the level way. The problem with regard to the other system was to make their wires inaccessible, and the answer was that they could do so. The second point raised was the liability to breakdowns, but electrically there was no reason why there should be more breakdowns in one system than the other. As regarded acceleration, there would be the same advantage in one system and the other. As to speed and margin, it was possible to run up to a maximum by the alternating motor, and anything short of it. They could go up as far as they liked, and he believed that at Berlin an alternating motor was to be applied to a military line to run up to 125 miles an hour. There was no doubt that by the alternating system they could get round the Circle as well as by the direct current, and under more economical conditions. If it was the intention to run quick trains on the outside, they would, under either system, have different motors. The last of the general propositions was that of cost. As regarded equipment, the tender of the Thomson-Houston Company for sub-stations and contact conductors showed the cost to be £247,000, as compared with £75,000 of Messrs. Ganz. He was advised also that there was a loss of energy of 13 per cent. in the continuous system, which would cost several thousand pounds a year. He also reckoned to save £4,500 a year on less wear and tear. Summing it up, his contention was that there would be a saving of £15,000 a year in working expenses under the Ganz system, and a saving in the initial expenditure of £150,000. Dealing with the point of control of the train, he claimed that nothing could be more simple or more effective than the system they proposed. In conclusion, counsel said he did not think anyone could doubt that the Metropolitan Railway had been actuated by one desire only, which was to get the best possible system for the Inner Circle traffic. Having regard to the actual conditions under which the traffic would be carried, he believed he would be able to satisfy the arbitrator that their system was the most efficient and the most economical.

Mr. O. T. Blathy, manager of the electrical works of Messrs. Ganz & Co., of Buda-Pesth, said that the successful use of transformers was first demonstrated in 1885. The three-phase system had been in operation on many Swiss railways with success. He did not admit that the system could be called an experiment, as he claimed that Messrs. Ganz had solved the matter and showed that it could be worked practically, safely and economically. Witness then explained at length the manner in which Messrs. Ganz would apply their system to the underground railway. They proposed to have one conductor along the rails and two overhead. There would be a 2½ minutes' service, and it would be necessary to have 40 trains running 620 train miles per hour. They proposed to have six cars on each train, the first and last of which would be motor cars. The total weight of the train would be 130 tons unloaded, or with a full load of passengers, 150 tons. Each motor car would have two groups of motors, so there would be eight motors on each train. There would be no danger to the public, because the motors would be entirely closed in.

The proceedings were then adjourned.

On Wednesday, November 6th, Mr. Blathy was further examined, and criticised the various tenders put in. The reason why it was easier in practice to obtain economy with the alternating current than with the direct current was that in the case of the alternating system the energy was supplied quicker, while the superfluous energy supplied would, to some extent, be recovered, whereas in the continuous system it was lost. Witness put in a table showing the running speed of trains under the Ganz system between different distances.

The Arbitrator said he took it that it was admitted there was an advantage in the system for long-distance runs.

Mr. Fletcher Moulton said he would admit that there might be some advantage.

Witness, proceeding, said the economy of his system came in by the less complicated transmission of energy from the central station to the train. It meant the saving of lost energy, which meant a saving of coal, &c., at the central station.

The further examination of the witness was postponed.

Mr. Gisbert Kapp, M.I.C.E., M.I.E.E., and general secretary of the German Association of Electrical Engineers, said he practised in England up to 1894, but had since been in Germany. He had had special experience of three-phase motors. For stationary work the tendency was to have multiphase motors, and the tendency was also to have multiphase working for heavy railways.

Mr. Moulton: I would like to know a single heavy railway working like that.

Witness: The tendency, I say.

Mr. Moulton: Oh, the tendency!

Witness, continuing, said the principal manufacturers of Germany were devoting a large sum of money to experiments in connection with a military line placed at their disposal by the German Government.

The Arbitrator said that he took it that that was the railway alluded to by Mr. Cripps, in which a speed of 125 miles was required. That was rather a long way from a line like the Metropolitan, with a speed of 25 miles and frequent stoppages.

Witness proceeded to compare the alternating and continuous systems, and said that as regarded power and energy required there was little difference between the two systems. What difference there might be would be due to local conditions, and it would certainly not be a difference so great that it would influence any engineer on the score of economy in selecting either one or the other. The number of watt-hours per train-mile gave the same time-table whether continuous or alternating. The amount of energy necessary to be put out from the central station would be more in the continuous run, simply because the conversion from alternating to continuous was more costly or less efficient by, perhaps, 7 or 8, or even 10 per cent. In that lay a difference of energy which ultimately meant a difference in coal consumption. The size of the high pressure feeder cables and the arrangement of these cables would be exactly the same in either case. It might be that they could branch off from the main cable oftener in the alternating system. The difference came in with the transformer stations, where in the continuous system converters and switchboards were required. With regard to working, there must be attendants with the rotary converters. There was a danger in the event of sleet or snow accumulating on the conductor rail in the continuous system, and this might be very objectionable in the out districts, although in the Inner Circle the frequency of the service would clear it away. He had visited the Valtellina line and thoroughly examined the whole working. Runs were made of 34 miles, and the highest speed attained was 40½ miles. At that speed the car ran perfectly smoothly, and the motor was under perfect control, and the speed could be varied at will. When the cascade was put on there was less jerking than when a Westinghouse brake was put on. Only one trolley was used on that line. Judging from the observations made at Valtellina, they would have an acceleration on the Metropolitan Railway of 2·6 ft. per second at the start, and they could get up to more than 1·5. Proceeding to deal with the details of Messrs. Ganz's proposals, Witness said he did not consider the use of liquid rear starts as a drawback. They had been used for 13 years, and he thought them much the best.

Mr. Parshall, one of the arbitrators, put a calculation to the Witness showing that 27 per cent. more copper was required in the main feeders with the Ganz system than with the continuous.

Witness admitted that the calculation was correct. From the point of view of safety, efficiency and cost, he preferred the alternating system.

In cross-examination by Mr. Fletcher Moulton, Witness said he had never been an engineer of any railway. He did not agree that the best engineers who were trying to use the alternating

system for traction were against the use of the concatenation system. He would suggest that they should leave the transformers without attendants. He did not say that ice and snow would prevent the working, but that it would interfere with the working. He did not know a single tramway wire which had been broken by snow or ice. He had only seen the working drawings of the motors for the Metropolitan Railway, and he did not know that the motors had been made.

Mr. Blathy was recalled, and explained that in the tender of the Ganz Company it was proposed to use the rail as a conductor. They certainly did not understand that the specification precluded this. As to the provisions for safety, all the high pressure currents were under the floor of the car. The whole of the conductors and switches were enclosed in substantial cast-iron casing. If there should be any failing in the insulation the effect would be that current would get to some metallic substance and thence to the ground. It would be absolutely impossible for any passenger or servant of the company to get to the high pressure wires, and no man, except deliberately, could come into contact with the current, which was in no case accessible.

The proceedings were then adjourned until Monday.

The arbitration was resumed on Monday, when Mr. Blathy was recalled, and was questioned regarding the safety devices to be provided for holding up any broken wires. He expressed the opinion that, with a reasonable amount of supervision, these safety devices were perfect to prevent a broken wire falling and reaching human beings. There was no doubt that 3,000 volts was more dangerous than 500 volts, but the dangers of the two would depend on circumstances. There had been cases of men being killed with 120 volts, but he had received 2,000 volts without being killed—it was true it was not a good contact, and he did not stand on perfect earth. With the safety devices, the 3,000 volts would not be so dangerous as the 500 continuous current which could be got at by passengers and employés. He had analysed the amount of energy required for the Metropolitan Inner Circle, the figure being based on the tests made on the Valtellina Railway. He found that for the Inner Circle 70·6 watt-hours per ton-mile would be required to do the run in 50 minutes. For a comparison of the cost of his system as against the rotary converter system, he thought they need only take the cost of sub-stations and of the contact conductors as the other items would be pretty equal. He calculated that the total cost of the sub-stations and contact conductors under the rotary converter system would be £220,000. Under the Ganz system the total cost of the overhead copper conductors would be £75,000, and there would be a saving on the Ganz system for the Inner Circle Railway as against the rotary converter system of £135,000 in the first cost. If steel rails were used by himself, the saving would be £140,000. On the outer lines, taking all things into consideration, he estimated that there would be a saving of £3,000 per mile by the Ganz system, compared with the rotary converter system. With regard to the cost of working, as the representative of Messrs. Ganz and Co., he was prepared to guarantee that for running round the Circle in 50 minutes, with 27 stops, and doing all the lighting and other incidental things, the necessary amount of energy from the switchboard of the generating station would not be more than 95 watt-hours per ton-mile. On the other hand, the Thomson-Houston tender showed that 15 per cent. more energy would be required. On those figures he estimated that there would be a saving in the coal bill of £6,000 a year, and there would be a further saving in the wages of attendants for the sub-stations of about £2,500 a year. There would also be saving in the Ganz system with respect to wear and tear. On the point of efficiency, he gave it as his opinion that the Ganz system would give improved security, because there were less elements to get out of order.

In cross-examination by Mr. Fletcher Moulton, Witness said Messrs. Ganz were paying for the arbitration by agreement with the Metropolitan Railway. He had no drawing of the trolley they proposed to use on the Metropolitan Railway in Court, and he did not know whether any such drawing had ever been made. Exactly the same trolley that they proposed to use had never been tried. It was true that the proposed trolley was not shown to the engineers of the District Railway when they visited Buda-Pesth, and he was sorry that they were shown so much. With regard to the proposals made by his firm, and what was shown to the engineers at Valtellina, he did not agree that neither the control, the rheostat, the motors, the acceleration, nor the frequency was the same as was now described to the Court.

Mr. Moulton: You have reduced the power by raising the acceleration from 1·5 to 2·6.

Witness replied to the effect that that was so.

Mr. Moulton: That makes it nearly 50 per cent. higher than what you considered in your former evidence was the maximum which could be taken without shock, and which in practice is respected. I put it to you that in practice 1·5 is taken as being the maximum which is to be taken without shock?—No; I put it that it can be done up to 3 ft.

Replying to the Arbitrator, Witness said the Westinghouse Company tendered for 2 ft. 2 in. He had not seen it in operation. If such an acceleration were put on at once, it would cause a jerk; but if it were put on gently it would not.

Further cross-examined by Mr. Moulton, Witness said the photographs which were put in were photographs of working drawings of motors. He could not admit that the drawings were insufficient, and that it would be impossible to construct a motor from them. Any manufacturer of polyphase motors could work from the drawings. A drawing of the device for the water rheostat and their control existed. It was made two or three months ago. It was not made until after the visit of the District Railway engineers to the Valtellina Railway. Those engineers did criticise the rheostat on the occasion of their visit. The construction for the control of the rheostat had never been made as proposed for the Metropolitan Railway. The system of the control proposed had never been tried even on the Valtellina line.

By the Arbitrator: The control was out of the power of the driver only so long as he wished it to be.

Further cross-examined: The safety devices for broken lines had not been tried either on their experimental line or the Valtellina line. They were not the same as those suggested in their tender, and had not been tried on a working line. He said the electrical outfit of the train would be the same, whether direct or alternating current was used, but he believed for the same power the alternating motor would be cheaper than the direct current motor.

Mr. Kando, vice-manager and assistant engineer of Messrs. Ganz, was called late in the afternoon, and stated that he had been designing polyphase motors for the past eight years. He endorsed the views which had been set forth by the previous witness as to the ability of the system to do all that was required on the Metropolitan Railway.

On resuming on Tuesday, Mr. Kando's cross-examination was continued. Speaking on the question of the polyphase system, witness said he thought any first-class electrical manufacturer could make motors that would go in cascade. The Ganz Company had experimented with the motors, and they attributed their success to the fact that they were not content with first results. It was important that the second motor should have a very high power factor, but he was not prepared to admit that without that excessive power factor their system would not work. They had devised a system of multiple control for their trains. All the parts had been experimented upon separately on their Buda-Pesth line, with the exception of the long air pipe, but they relied upon the Westinghouse experience for that. He did not see that there would be any practical difference in working their system on the underground railway to that experienced on the experimental line, because he was convinced that they had shut every door to mistake. If there was a possibility of anything going wrong it would make a great difference, but the same remark would apply to the continuous current.

In re-examination, Mr. Kando said that the power factor of the combined motors was 77 to 78 per cent.

Prof. Ewing, examined by Mr. Wallace, said he understood both the schemes of electrical traction that had been proposed for the underground railways, and it seemed to him that the most appropriate name for one scheme was a mixed scheme, while the other was consistently polyphase throughout. The very fact that polyphase currents were used in the mixed scheme to convey power from the generating stations to sub-stations, was an admission of the advantage of transmission of polyphase currents. He believed that in time electrical engineers would cease to perform what seemed to him to be an entirely unnecessary operation by converting the alternating current into continuous current. He did not think it was fair to call either of the systems experimental except in so far that in dealing with the underground railways fresh points were sure to arise, and in that respect both systems would be, to an extent, experimental. The most recent electric railway that had been experimented upon was the Berlin—Zossen military line, and there they were using a pressure of 10,000 volts on a trolley line.

The Arbitrator: Is the stage which this line has reached beyond the stage of experiments?—Has it ever been proposed to carry any portion of the public upon it, even the military portion?

Witness replied that he believed the line was an old one, and that it was being converted into an electric line. So far, he believed, it was only in the experimental stage. He regarded the Thomson-Houston system as being less economical than the Ganz. There would be a lot of power wasted on the starting of the trains between two sub-stations. The effect of that would be that very much larger conductors would have to be used than by the polyphase system. The difficulty could be got over by using a large number of feeders and a large number of sub-stations, but there was no provision in the Thomson-Houston tender for feeders. Those difficulties would vanish with the Ganz system, as there would practically be no loss whatever in the conductors. That advantage would increase as the length of the line increased. He did not think that continuous currents would ever be practicable for long-distance railways, and besides that, the cost would be prohibitive. So long as one was dealing with simply a tramway service, the continuous current undoubtedly possessed great advantages, but that was not the case in regard to a railway where much larger quantities of current were required. In both systems it was necessary to use two insulated conductors, and therefore on that point there was nothing to choose between them. They could escape the use of two insulated conductors on the continuous system by a very liberal use of feeders to take the current along, but that was not proposed in the present case. The conversion of the current introduced an additional possibility of something going wrong. If it were merely a question of applying a system of electric traction which would satisfy the needs of the Inner Circle Railway *per se*, then all one could urge against the continuous current would be that it would entail extra expense, but he thought one had to consider the Inner Circle in relation to other lines. He had no hesitation in saying that if electric traction was coming on railways it would be on the polyphase system, and he believed they would see the time when the Inner Circle would be a mere detail as far as electric lines were concerned. He did not think there could be any doubt but that the current of the future would be the polyphase and not the continuous current. The former was much better suited for gradients, as it enabled a uniform speed to be obtained at all points.

Questioned as to the safety of the proposed system on the Under-

ground, Witness said he did not see any danger from the overhead wires, although he would prefer to have a rigid instead of a flexible trolley wire. He did not see that there could be any possible danger either to passengers or to engine drivers—in fact, with the precautions that Messrs. Ganz proposed to take, in his opinion, the 3,000-volt working would be not only as safe, but absolutely safer than the 500 volts if carried out in the ordinary way.

Cross-examined, Witness said he would not say that the problem before the Arbitrator could not be satisfactorily settled by the direct current system, but it would undoubtedly be more expensive. That opinion was formed on a general survey of the whole problem to be solved.

Questioned with regard to his statement that there would be new points in both systems as applied to the Inner Circle, Witness said that in the direct current system they would have to deal with the magnitude of the current and with conditions which he thought were somewhat unique in regard to the possibility of a large number of trains happening to be started simultaneously, and consequently causing a very severe rush of current. He was aware that the direct current system had been applied successfully to large railways in America, and he did not mean to imply that it would be impracticable to apply that system to the Inner Circle.

The Arbitrator: I think the witness said this morning that if cost was left out of the calculation, there was nothing to be said against the practicability of the continuous current system.

Mr. Cripps: That is the point we have taken all along.

Continuing, Witness admitted that there would be more points of novelty in the Ganz system than in the direct current system.

Major Cardew, consulting electrical engineer, said he was now working in partnership with Sir W. Preece. Since 1876 he had been closely connected with electrical engineering, and from 1888 to 1899 had acted as electrical adviser to the Board of Trade. The direct system, which was applied to the City and South London and the Central London Railways were the best for these particular lines, but he considered that the problem was distinctly modified in the case of the Inner Circle from the fact that it was connected with the whole railway system. He did not think that the third-rail continuous current system would be economical as applied to lines of any considerable length. The equipment would cost more, and so would the upkeep. There would not be so much loss in the conductors under the polyphase system, and there would not be so much skilled attendance required. He estimated that there would be a loss of about 10 per cent. of energy on the direct current system against 4 per cent. in the polyphase system—a difference of 6 per cent. in favour of the Ganz system. Originally he did not look with much favour upon the three-phase system for traction, but he believed now that with the amendments which Messrs. Ganz had introduced the system would work more efficiently than the continuous current. He had been to Buda-Pesth and seen Messrs. Ganz's experiments. He did not put that as an absolutely proved statement; at present it was only the opinion which he had gathered from observations he had taken. He would like to make tests on a railway thoroughly equipped.

Mr. Cripps: What have you to say on the question of the comparative safety of the two systems?

Witness replied that, with the 3,000 volts, there was no denying that the pressure was such as to be extremely dangerous if a person came into contact with it, but if the conductors were quite inaccessible, and if proper provision was made in the event of any rupture, that they were harmless before they could touch anybody, then he did not see that there was any danger in it. He did think there was a certain element of danger in the 500-volt system. The Board of Trade originally drew the line at 300 volts under his advice, but they had never said that 300 volts was absolutely safe, but simply that additional precautions must be taken when 300 volts was exceeded. When electric traction came into vogue for street tramways the line was drawn at 500 volts. Any difficulty as regarded the accidental breaking of the overhead wires could easily be got over. He did not think there was any unknown danger in the Ganz system, and when a danger was known it ought to be able to be provided against. With regard to the two tenders—the Thomson-Houston and the Ganz—they differed on a great many points, and it was very difficult to make any exact comparison. What it practically came to was this—that Messrs. Ganz had put in a great deal more power in the generating machinery, and not so much in proportion in the engines and boilers. As regarded the control under the Ganz system, it was simple and reliable. There was no difficulty in the Ganz system so far as the junctions on the Inner Circle were concerned. All crossings and junctions were a nuisance on electric railways whatever system was used.

Replying to the Arbitrator, the Witness said the advocates of the Ganz system were taunted that it was an experimental system, and he did consider that it would be desirable before equipping the whole of the Inner Circle, to equip a portion as an experiment—in fact, the Board of Trade would insist upon it, in order that they might see whether the system would work satisfactorily and with safety to the public. Such an experiment could be made at very little cost and could be done in about a fortnight. His only desire in the matter was that the best system should prevail, and that Ganz & Co. should have fair play.

The inquiry was adjourned.

(To be continued.)

Dover.—The Corporation of Dover has agreed to purchase the electric light works, and to apply for Parliamentary powers to work them. The purchase price is £129,000.

LEGAL.

Wigham, Richardson & Co. *v.* Walker Urban District Council.

In the Chancery Division of the High Court of Justice on 8th inst., before Mr. Justice Buckley, Mr. Birrell, K.C., renewed a motion by the plaintiffs in this action, in which they sought an injunction to restrain the defendant Council from interfering with electric mains under Fisher Street, Wallsend, which supplied electric energy to the plaintiffs' works. The learned counsel reminded his Lordship that on the previous Saturday he applied for *ex parte*, and obtained an injunction over that day restraining the Council from interfering with the mains. The defendants had continued their work, and expressed their intention to do so. They were now very near the electric wires, and affidavits had been put in by the defendants, but these he had only seen that morning. By these affidavits the defendants practically claimed the right to remove the electric mains. Proceeding, the learned counsel said he must answer the affidavits, and therefore he asked that the motion should stand over for a week. He understood, however, that the defendants could not give an undertaking, as they had no power under their Act of Parliament.

Mr. Astbury, K.C., who, with Mr. R. J. Parker, appeared for the defendants, said he could not give the undertaking asked, as it was contrary to the Act. The Council were bound to do what they were doing, as the road was unsafe.

Mr. Justice Buckley: Then you object to the order being continued?

Mr. Astbury: Yes.

Mr. Justice Buckley: Then I must hear the motion.

Mr. Birrell reminded his Lordship that it related to mains 19 ft. below the surface of the roadway. Much more important litigation was pending between two statutory authorities as to the right to supply electricity outside their districts. No doubt the plaintiffs took their electric supply from the Gas Works Company, and a portion of the plaintiffs' premises was outside their district. That litigation was, however, not before this Court. The section of the Public Health Act, upon which the defendants relied, gave the local authority power to remove any tunnel, vault or arch that had been constructed under a public road without consent. The mains in question were originally carried under Fisher Street by an arch, but the arch had been removed and the space filled with cement. The wires were in the cement. Defendants said that they were making the excavations for the purpose of seeing what had been done by the plaintiffs.

Mr. Astbury said that defendants' evidence was that a subsidence had taken place, and what they were doing was necessary for the purpose of rendering the road safe.

Mr. Justice Buckley remarked, that looking at the defendants' own plan, he did not see that in removing the vault or arch, it was necessary to interfere with the wires.

Mr. Astbury said the archway went underneath the mains.

Mr. Justice Buckley: The arch itself could be removed without disturbing the mains.

Mr. Astbury: They could remove the arch but not the floor.

Mr. Justice Buckley: And that is all they want to do. The floor of the arch would not cause subsidence.

Mr. Birrell said it was for the benefit of all parties to have this question determined as speedily as possible, and he suggested that the motion should be treated as the trial of the action, and heard at an early date. The plaintiffs were the largest ratepayers, so that the bulk of the costs must fall upon them.

After some discussion it was agreed that the motion should be treated as the trial of the action, to be heard by Mr. Justice Farwell, before whom an action by the defendants was pending. The interim injunction will be continued until after the hearing, which it has been arranged shall not be for a fortnight.

Hampstead Electrical Supply Company, Limited.

Before Mr. Justice Wright, in the Companies' Winding-up Court of the Chancery Division, on 8th inst., the petition of Mr. R. Wheelock, for the compulsory winding up of the Hampstead Electrical Supply Company, Limited, came on for hearing. Mr. Eve, K.C., and Mr. Martelli, were counsel for the petitioner, and Mr. Rufus Isaacs, K.C., and Mr. Cozens-Hardy appeared for the company.

Mr. Eve said it was a case in which his Lordship had made an order for the attendance of a witness. The witness was the Chevalier de Soares, and there was a medical certificate to the effect that he was too ill to appear. He was an original director.

Mr. Isaacs said he was very anxious that the matter should not stand over, and that the charges which his friend's clients had made should be met. He suggested that they should dispense with the witness, and this was agreed to.

Mr. Eve, proceeding, said the petitioner was the holder of fully-paid shares, and the petition stated that the substratum of the company had gone, and that it was unable to pay its debts. Those allegations were substantiated by the evidence filed in answer to the petition. It was stated in the affidavits, however, that the company could pay its debts if a reconstruction took place, and further capital was brought in.

Mr. Abrams said he appeared for creditors representing £5,000 to oppose the petition.

Mr. Gilchrist Alexander, for creditors for £6,000, also opposed the petition.

Mr. Eve, continuing, said his client's contention was that the

company had no chance under any reconstruction of paying its debts, and that any chance of its ever being able to do so had been thrown away by a change in the circumstances which had arisen since its formation. The company was formed in July, 1898, and its objects were to supply certain districts of Hampstead with electric light. The way in which it was to do it was by the acquisition of the goodwill and liabilities of a company called the London and Hampstead Battery Company, Limited, which had entered into arrangements with builders and others to pass cables or lines of wire over the roofs of house, and to supply the houses with electric light. They also had to acquire the business of a Mr. Joseph Taylor, a cab proprietor and jobmaster. The purchase money which the company was to pay was £165,000, payable as to two-thirds in ordinary and preference shares and as to the balance partly in cash and partly in shares. That was modified, and debentures were substituted for certain of the cash payments. The first point he took was, the company was promoted by a Mr. Catton. For some reason, which the witness who had been summoned would probably explain, if he was present, in the prospectus issued to the public, Mr. Catton's name was dropped, and the name of his clerk, a Mr. Rainbow, was substituted as promoter. The purchase money was paid, ostensibly to Mr. Rainbow, but really to Mr. Catton, and the latter was appointed a director, and remained a director until April 27th, 1900. By that time the whole of the purchase money had been paid, in meal or in malt, to Mr. Catton. Then the directors issued their first and last report and balance-sheet to the shareholders. That report was up to the close of the year 1899, and stated to the shareholders for the first time that four classes of debentures had been created. Mr. Catton's name then disappeared as a director, and his suggestion was that he was concealing his connection with the company. It was in evidence that, at that time, or at any rate in January, 1900, Mr. Catton was unloading the shares which had been allotted to him in the company by means of circulars issued by brokers acting on his instructions. There was the fact also that an interim dividend was declared on the preference shares out of capital, and that Mr. Catton was concealing his identity as a promoter and owner of preference shares; also that he had been unloading his preference shares on the public. Counsel then proceeded to draw attention to the way in which contracts had been entered into on behalf of the company, and to the statements in the prospectus. These latter set forth that the company had powers as to the supply of electricity in Hampstead which it did not really possess. He contended that the company as at present constituted could not go on. It was admitted that there must be a liquidation, and it was proposed that there must be an assessment of 25 per cent. on the existing shareholders. This his client was opposed to, and to any reconstruction on that basis.

Mr. Isaacs said there must be a reconstruction for the purpose of getting more working capital.

Mr. Isaacs said that counsel for shareholders to the amount of £80,000 odd appeared to oppose the petition.

Mr. Eve said he did not accept his learned friend's statement that these shareholders were wholly independent in the matter. Nearly half of them were connected with the promotion of the company. He proceeded to argue that the company was built on a foundation which did not, so to say, really exist. It was not in such an advantageous position as was set forth in the prospectus, and there were misrepresentations made which the Court should inquire into.

His Lordship asked what the assets of the company would realise after the payment of the debentures.

Mr. Eve said there would not be sufficient to pay all the debenture holders, and they had not an atom of information as to the circumstances under which the debentures had been issued. The shareholders who were "not in the ring" knew nothing.

His Lordship said that Mr. Eve could not succeed on the petition unless he showed cause for the displacing of the debentures.

Mr. Isaacs said that the receiver for the debenture holders was in court, and he could tell his Lordship that he was now carrying on the business of the company at a profit, so that his learned friend's contention that the substratum of the company had gone fell to the ground. All the company wanted was further capital.

Mr. Eve said he could not accept that statement. To get further capital meant the extinction of the present company. If they could get rid of the £165,000 paid to the promoter there would be substantial assets.

After some further argument, it was stated that there would be a meeting of the company on the 12th inst. to appoint a voluntary liquidator.

His Lordship said that Mr. Eve's clients would be protected if the liquidator was a person appointed by the Court. He was anxious to do what was right in the matter. Would Mr. Isaacs give an undertaking that the voluntary liquidator should be subject to the approval of the Court?

Mr. Isaacs: Certainly.

His Lordship said that the proposed reconstruction of the company might at some future time be brought before the Court for review. He thought that if the voluntary liquidator to be appointed was subject to the approval of the Court, that would meet the case. When there was such an overwhelming majority of shareholders against a compulsory order, he could not go further. The petition would be dismissed, but the voluntary liquidator to be appointed must be subject to the approval of the Court. There would be no order as to costs at present. As to future proceedings against the directors for misfeasance, &c., he must not be understood to express any opinion. At present he thought sufficient protection had been given. Of course, the dismissal of the petition did not prejudice any further petition that might be presented.

Wrigley *v.* the Windermere and District Electric Supply Company, Limited.

In the Chancery Division on 7th inst., before Mr. Justice Kekewich, the case of Wrigley *v.* the Windermere and District Electric Supply Company, Limited, was heard. The plaintiff sought an injunction to restrain the defendants from continuing an alleged nuisance by noise, vibration, and smoke. The case had been previously before the Courts, and a gentleman had been appointed to visit the *locus in quo*, and make a report for the guidance of the Court. That gentleman had reported to the effect that there was a nuisance by noise, and the case was allowed to stand over to see what remedy could be provided.

Mr. Warrington, K.C., and Mr. Gatey appeared for the plaintiff, and Mr. P. Ogden Laurence and Mr. Grant for the defendants.

Mr. Warrington, on the case being called on, said he was glad to say the parties had been able to arrange an order. The defendants did not admit that there was a nuisance by vibration or smoke, but admitting that the plaintiff was entitled to an injunction restraining them from carrying on their works so as to cause a nuisance by noise, the defendants would continue the undertaking given on a prior occasion to use their best endeavours to abate the nuisance, and would pay to the plaintiff any costs of the action up to and including the date of the order, with liberty to the plaintiff, after the expiration of six months, to apply for an injunction, should he be so advised.

His Lordship made an order on the terms agreed.

CORRESPONDENCE.

The Economics of Ordering Machinery Abroad.

I accept the correction in title that "J. W. B." makes in his letter, though in this matter, ethics and economics so run into one another that it is impossible to find a line of demarcation.

I did not look at the question from a world point of view, but merely from the British, and his letter read carefully only carries the argument a step further.

All business is simply barter undoubtedly, and with the exception of coal, we have to barter manufactured articles for raw material and food-stuffs, and, therefore, the more we can manufacture, the more wealth we have with which to buy such commodities, if necessary, or to lay by for the future.

How does it profit us, ordering £600,000 value of machinery from abroad; does America buy any more goods from us because we place our orders there; do they not do their best to keep our goods out of their market? Does Belgium reciprocate when we order dynamos and switchboards from them; do they not rather try and boycott us and help our enemies in South Africa? Switzerland and Germany, friendly with us now as they are, cannot take anything more from us than they do; they require raw materials and food-stuffs, even as we do, and get them from America and Russia, and perhaps from our Colonies; their buying wine from France may help us indirectly, but it would be difficult to prove. The wools from England are rather a bad example, as England buys more wool from abroad than any other country, to manufacture into yarn and cloth and export again, getting the value of the labour spent on it.

The concrete case given concerning street railways depends on the questionable rise of wages; if foresight and patience were used, wages would not rise to any great extent, as at present we have booms for one, two or three years, and then periods of depression for nine or ten years; there are, worse luck, so many hours of idleness in a decade that if all the machinery now imported from abroad were made at home, there would still be some slack times. Besides this, the English mechanic is highly paid now, and a very little rise in wages would bring in fresh workers from other trades.

It is very possible that if the prices of foreign machinery are lower than British, and we go on ordering abroad in sufficient quantities, that they will in time go up to the home level; we shall have nevertheless lost the value of the labour on those orders, and we shall in the position of the British workman who goes out on strike, and loses more in wages in a few months than he can get back in the rest of his life, even supposing he succeeds in getting the additional wage for which he struck work.

After all it is largely a matter of degree; it is plainly evident that it pays the country to import any article which it can get at a less price than that at which it can produce the raw material, of which that article is composed; it also

pays to import any manufactured article which will pay for the value of the labour in itself in the time between an early delivery from a foreign workshop, and late delivery from a home one, the value being the actual value to all concerned, and not necessarily merely the money earned by the proprietor of the article.

Is there any other class which it pays to import?

Percy Rosling.

Electrical Contracting, and Why It is Abused.

The gentleman signing himself "Business, not Starvation," who has been stung into a sarcastic paraphrasing of the title of my letter upon "Trade Discounts, and the Abuse of Them," evidently belongs to that school of persons who believe that two wrongs make a right. My letter dealt simply with the question of trade discounts, and incidentally I mentioned the sentence quoted by your correspondent, not because it was a practice of which I approved, but simply because it was an undeniable fact. Thereupon "Business, not Starvation," apparently being at a loss to find an argument in defence of the abuse of trade discounts, fastens upon this sentence, and tries to draw a herring across the trail by raising a side issue, and endeavouring to use my words as a weapon for the defence of the abuse of which I complained.

This, Sir, I venture to think, is somewhat beside the mark, but as your correspondent is of the opinion that the argument he has raised needs a satisfactory reply, with your permission I will endeavour to answer the questions put. It appears to me that the first and third may be met with the same answer. Presuming the industry to be still in its "swaddling clothes" (though, by-the-bye, it must be getting a good sized baby now) it cannot be denied that it is one of the most overrun trades in existence. Possibly "Business, not Starvation" is unaware of the existence of such a thing as "competition," and that competition, aided by the abuse of trade discounts, is *more* than sufficient to bring even the "infantile" trade of electrical contracting to its present pass. It is not really so wonderful after all, but surely your correspondent was joking when he asked whether the profit was lost because the consumer knew the price of wires and casings. No, Sir, *that* is not the cause, it is because electrical contractors have not only to meet the opposition of the gas companies, but they have to contend against ironmongers, plumbers, gasfitters, builders, sanitary engineers, furniture dealers, stores, drapers, and last but not least, the "wireman by day and contractor at night"; competition that would not be practicable were it not for the abuse of trade discounts. It is this, and this alone, that makes the present deplorable condition of the trade possible, and it is to do away with this state of affairs as far as possible that the Electrical Contractors' Association has been formed, and is now working. It must not be inferred from the fact that I have shown why contractors have to look to the discount on the fittings for their profit at times, that it is so in the majority of cases, for my words were, "it not infrequently happens," and by those words I abide. As regards the second question I can only reply, the smallest amount of common sense (and it is possible for a contractor to have a little), and in addition, the words selected for your correspondent's *nom de plume*. Might I add that this question of discounts does not only apply to the sale of fittings, which is described by your correspondent as the fringe of the business, but is equally applicable to the sale of accessories, cables, arc and glow lamps; in short, to all kinds of electrical supplies. Having done my best to answer the questions raised, there is nothing left for me to say, except to acknowledge that I have yet to learn the justification of the abuse of trade discounts.

Sidney Frost.

If the gentleman who signs himself "Business not Starvation," tried to establish himself as a wiring contractor in a provincial town, he would very soon know why the trade is so cut up that contractors have to depend on the discount off fittings for their profit.

I recently started business in a small town of about 25,000 inhabitants, months before the electricity supply commenced, where there seemed a fair opening for a wiring contractor with apparently only one rival in the place; judge then my surprise when I afterwards found there were no less than 15 different contractors to compete against! Firms established in towns over a hundred miles away, and firms nearer to hand, sent canvassers to systematically canvass the place, till it was overrun with them, and all cutting one another's prices.

What, I wonder, would your correspondent think of that, and in only a small town. Yet the trade, he thinks, is only in its swaddling clothes. In my humble opinion it has been breeched long ago.

I enclose my card, but sign myself as

Disgusted.

Multiplicity of Tenders.

Allow me to entirely endorse in the strongest way I can the expressions appearing in your paper with regard to multiplicity of tenders. I do think that from a commercial point of view the engineer should buy his plant direct from the manufacturer. He will thus obtain it at less cost because, of course, if a firm has to guarantee a sub-contractor's plant it will require to be paid to do so. Of course, there is more responsibility on the engineer, but surely if an engineer is worthy of the position he holds he should be able to take this responsibility. Contractors have enough to put up with in having to tender for plant which they make themselves, without having to send in some dozen or more tenders for other people's plant. I feel sure that after the prominence given to this matter engineers will be able to meet the contractors in this matter.

I enclose you specification of the plant which is advertised in your issue, from which you will doubtless see that there are two sections, one for the engine builder and one for the alternator maker.

I also enclose you copy of letter which is sent out with each specification.

Jos. A. Jeckell,
Manager.

Coventry, *November 11th*, 1901.

[COPY.]

Corporation Electricity Works, Coventry.

Dear Sirs,—I beg to acknowledge receipt of your cheque, value five guineas, and have pleasure in handing you specification herewith.

If your standard sizes are different to the sizes of the plant specified, I shall be quite ready to consider a tender for your standard size, or if you find you cannot conveniently send in a tender, on receipt of the specification within three days, I will return the deposit.

The specification shows what I would prefer to obtain if I can get it at a reasonable cost, but at the same time I wish, if possible, to purchase plant of a standard size and make.

Yours faithfully, &c.

[Mr. Jeckell's letter and enclosure show precisely that spirit of common-sense dealing which we have so strongly advocated. We are convinced that by following this practice greater satisfaction will be gained by all parties—including the ratepayers, who will get better material in shorter time and at a lower price.—EDS. ELEC. REV.]

The Pay of Assistant Engineers.

I see that this subject, together with kindred ones, seems to be causing much interest in your paper, and it is one that ought not to be dropped. To offer the salaries advertised to men, who, in the terms of the advertisement, must be "competent electrical engineers," is little short of an insult to the profession, and simply shows the ignorance of the different town councils as to the numberless, hard earned qualifications that such an engineer must possess.

In this week's REVIEW I see yet another advertisement from ——, for an assistant engineer at £78. If the Corporation of Darlington imagine that they can get a duly qualified engineer at a wage less than that given in many cases to a fitter or wireman, they must be labouring under a somewhat large delusion.

A cheap engineer is an expensive article, as many corporations will soon find out, and it will be well for them to remember the motto about "penny wise and pound foolish."

I thoroughly sympathise with "Pater" and Bennett, and quite agree that the time has come to improve the status of station engineers in the matter of pay and qualifications. It is certain, however, that the pay must be increased first, or men with the necessary qualifications will not be forthcoming.

Mr. Boot's letter from Tunbridge Wells has caused me much amusement. He seems to overreach himself in his eagerness to show how efficient and contented his staff are. While admitting that Mr. Boot is essentially the person to judge of the efficiency of his staff, I do not see that he can be considered an impartial judge of their contentedness, seeing the discrepancies in the salaries of himself and his assistants.

It is not for a man in receipt of the salary of £500 a year to judge the minds of others in receipt of £150 or £100, and the drop in salary between the chief engineer and the assistant seems out of all proportion.

Justitia.

Examination Test for Electrical Engineers.

This heading, I think, is one of the finest and most important that has ever been brought up for discussion in connection with central station work. It is the first and most essential point in a station to have a thoroughly proficient chief. The idea is quite a practical one, and should be carried out for the benefit of our country, if nothing else. Let us outstrip other nations in this also, and not let it be the *only* feature in which we cannot boast of being first.

Why not have examinations for chiefs and assistants similar to those in which you get your ticket at sea?

Have, for example, an examination consisting of both practical and theoretical work in mechanical and electrical engineering, draughtsmanship, estimating, and business transactions of various descriptions.

There are clever men who never get a chance on account of the hum-scrum way some committees have of electing their chiefs.

They consider this man not competent enough because he has not got a stack of glowing testimonials, and the next because he has not served a full apprenticeship and has no influence, and thus clever men are lost to the world. If *this* is considered too laborious a task or thought not worth while attempting, then I consider that instead of rapidly advancing a science worthy of the name, we will remain stagnant, or perhaps deteriorate to the extent in some future time of being ridiculed by smaller and far less important nations than our own.

What do we live for? Why, that each man should do his utmost to advance the subject which he has chosen for his special career, and that men as a body should live to advance the career of the nation to which they belong.

W. G. R.

Mr. Bennett has my sincerest sympathy. His case goes to prove my contention, that the possession of influence rather than capability is the way to secure work in the electrical engineering profession. It is high time some test was applied. It is for the members of the profession, especially its leading members, to take the matter up. Since I last wrote to you, I have heard of a thoroughly trained man, with some five years' practical experience as an assistant in a very large station, being passed over in favour of a man whose sole qualification was two years spent in a moderate sized station.

I would suggest to Mr. Bennett that he applied to some of the cable companies for the post of superintendent.

Pater.

Poplar Hospital Electrical Work.

A controversy has arisen at the meetings of the Electric Light Committee of the Poplar Guardians as to the manner in which the electrical work at the workhouse has been carried out by certain contractors under the supervision of their consulting engineer.

Statements have been made in the daily press concerning "Boy Labour" and "Foreign made goods," and concerning the latter, it was stated that the reason the contract went to Messrs. ——, was because they were cheaper than any English firm who tendered, and that no English firm would give guarantees as to efficiency and economy according to the requirements of the specification, which included a "Trade Union Labour" clause. It was also stated that all the trouble was caused by Mr. Stephens (our managing director), who is a member of the Committee, because our firm did not obtain the contract.

This statement may be dismissed, as no firm expects to obtain all the work tendered for, but when it is publicly stated that the work has to go to Sweden, because no English firm would give the guarantee required, we think in the interest of the English manufacturers it should be publicly demonstrated that these machines do come up to the required standard.

We would therefore suggest that in order to set the matter at rest, the consulting engineer should have these machines tested by an independent electrical engineer, a representative of each party interested to be present. If they come up to the guarantee, Mr. Stephens will give £5 to Poplar Hospital, whilst if they do not do so, then the Chairman of the Committee, the consulting engineer and the contractors should each pay £5 to the Hospital.

Stephens, Smith & Co., Limited.
John Stephens, *Managing Director.*

November 12th.

Coal Consumption Per Unit in Power Stations.

In asking for further information *re* "W. H. J's." unusual figure of 2 lbs. per unit, I used in my argument his stated load factor of 50 to 55 per cent. It was my intention to have added that this running plant load factor is practically valueless as an aid in estimating engine performances. The running plant load factor, as "W. H. J." says, is the ratio of the mean output to the rated output, but there is no such thing as a standard rated output. One maker's engine does not compare with that of another maker's, and probably no maker rates his engine at the power of its economical output. Americans who are far from liberal in their generator ratings and supply machines that are really unfit to run long at rated steady loads, often supply engines to drive those generators which will run more economically at overloads of 25 per cent. than at their normal rating. There is, therefore, no meaning in the running plant load factor in the absence of further particulars. The station load factor alone is useful, by which I believe is generally understood the ratio of mean to maximum output, such maximum output being the highest momentary readings of the ammeter permitted to occur by the circuit breaker. Possibly the station load factor of "W. H. J." is higher than 55 per cent., in which case we may surmise that he has more than 125 cars (average constantly at work), but the effect of this would not seriously affect the argument of my last letter for any station at present in the British Isles. The results claimed would be more than excellent with a steady load of 500 cars run full station hours.

W. H. Booth.

West Norwood, *November 10th*, 1901.

In my letter in the Review, 1st inst., *re* above, I stated that for reasons which could not be made public, I regretted I was unable to give the type of plant in use.

I think the wishes of correspondents should be respected, especially when the reasons have no bearing on the point at issue.

I therefore cannot understand why Mr. Booth should act the part of Sherlock Holmes by trying to locate the station from the fact of its using Welsh coal.

A glance at the Supplement of the Electrical Review will show Welsh coal in use in many districts other than those mentioned by him.

In the Review, September 13th, I published the results of coal consumption per unit for two shifts—viz., 2·1 lbs. and 2·36 lbs. respectively (or an average of 2·2 lbs. per unit generated in 16 hours), from which I think any steam engineer will conclude without further details that 3 lbs. per unit will cover all stand-by losses, and leave a margin on the right side.

With reference to *my* definition of station load factor, which he defines as plant load factor, I think my figures convey the same meaning as his words in the article on load factors, Electrical Review, October 11th; if not, I should be glad to have the difference explained.

In the same article Mr. Booth allows a station load factor of 67 per cent. for an average of 125 running cars; this being so, I am safe in assuming a load factor of 50 to 55 per cent. for an average of 5 per cent. more running cars.

Mr. Booth assumes the units are measured at the switchboard, which is correct; so far as I am aware, it has always been the recognised place.

The current output is measured by wattmeters on each generator, which have been checked twice in the year; besides, as there are different generators running every day, the wattmeters check one another, and with a recording ammeter for the total output on the switchboard bus bars, there cannot be much error in this direction.

The coal is weighed by the contractor and checked on arrival at the power station, and weighed every hour during consumption to each boiler.

As the last weighing apparatus is checked by weights in general use, and the amount of coal in stock can be determined at a few hours' notice, I think this a fair check to ensure accuracy; under these circumstances, there is no need to send a postcard to the coal merchant.

In conclusion, in a station which daily shows the number of units generated to be something over 50 per cent. of the maximum output, with feed water from 240 to 260°, and a 27-in. vacuum, it is only natural to look for something like a record.

In my first letter I stated I was *a* charge engineer, by which I mean engineer-in-charge of a shift; as some readers think it means charge of the station, I beg to correct the misapprehension.

I regret having to trespass at such a length on your valuable space. I only do so to show what can be done in a station well designed and efficiently managed.

W. H. J.

Marine Engineers.

A candidate for marine engineer's Board of Trade certificate must serve five years' apprenticeship at the making or repairing of engines; for second class certificate he has to sail as third or fourth engineer, but must be in charge of a watch, and he is required to show 12 months' sea time *foreign*, or 18 months' coasting; sea time counts from the day he signs on till he arrives back and gets his discharge certificate. Candidates for first class certificate must sail as second or third where there are no less than four engineers carried. A candidate can go up for extra first class after he gains the ordinary first class certificate, and this examination will cost him nothing for the first attempt.

T. B.

Liverpool.

In answer to "Shift Engineer's" inquiry *re* experience to qualify for engineer's ticket, I have given the Board of Trade rule on the subject:—

He must have served an apprenticeship to an engineer for three years at least, and prove that during that time he has been employed on making or repairing engines; or if he has not been a bound apprentice, he must prove that for not less than three years he has been employed as a journeyman mechanic in some factory or workshop on making or repairing of engines (they may be either land or marine engines). No period of service in a drawing office can be allowed to count for more than six months' workshop time.

In either case he must also have served one year at sea in the engine room as an engineer on regular watch in the foreign, home, or coasting trade.

F. . Wilson.

The Philippine Islands.—The import duty, under the new Customs Tariff, imposed on "dynamos, generators, exciters and all other machinery for the generation of electricity for lighting or for power, also transformers" imported into the Philippine Islands, has been fixed at $5 per 100 kilogrammes.

BUSINESS NOTES.

Universal Electrical Directory.—The 1902 issue is now in preparation; alterations in existing entries and new names should be sent in at once to H. Alabaster, Gatehouse & Co., "Berly" Department, 4, Ludgate Hill, London. E.C. Advertisers who have not yet sent in copy, blocks, &c., are requested to do so as early as possible.

Electrical Wares Exported.

Week ending Nov. 13th, 1900.		Week ending Nov. 12th, 1901.	
Amsterdam	Value £155	Aden. Teleg. cable	Value £87,960
Barcelona	25	Amsterdam	20
Bombay	181	Auckland	66
,, Teleg. mat.	121	Bombay	582
Calcutta	1,267	Brisbane	29
Cape Town	83	Buenos Ayres	783
Channel Islands	289	,, Teleg. mat. ..	518
Christiania. Teleg. wire ..	55	,, Teleg. wire ..	268
Colombo	341	Calcutta	1,157
Copenhagen. Teleg. wire ..	125	,, Teleg. wire	80
Durban	245	Cape Town	375
Emden. Teleg. mat.	57	Christiania. Teleg. wire ..	76
Gothenburg	23	Colombo	22
Halifax. Teleg. cable	6,000	Copenhagen. Teleg. wire ..	169
Hiogo. Teleg. cable	770	Demerara	10
Launceston	441	Durban	606
Madras	26	East London	10
Melbourne	1,737	Gothenburg	491
Montreal	200	La Plata. Teleg. mat.	75
Monte Video. Teleg. mat.	165,723	Launceston	185
Ostend	170	Lyttleton. Teleg. mat.	251
Otago	57	Penang Teleg. cable	741
Penang	47	Port Chalmers	70
Riga	258	Rosario	74
Rio Janeiro	175	St. Petersburg	82
,, Teleg. mat.	7,157	Shanghai	177
Santos. Teleg. mat., &c. ..	35	Singapore	485
Shanghai	150	Sydney	720
Singapore	206	Trinidad	100
Stockholm. Teleg. mat. ..	401	Wellington	76
Sydney	1,849	Yokohama	84
,, Teleg. mat.	360		
Wellington	312		
,, Teleph. mat. ..	200		
Yokohama	135		
,, Elec. dynamos ..	2,850		
,, Teleg. cable	7,586		
Total ..	£199,801	Total ..	£96,276

Foreign Goods Transhipped.

Bangkok. Elec. lamps ..	Value £73
St. Petersburg. Elec. light fittings	11
Total	£184

The "Aston" Lantern for Electric Street Lighting.—Messrs. Veritys, Limited, of Covent Garden, are supplying the "Aston" patent street lantern, which is shown in the accompanying

illustration. This lantern has been specially designed for obtaining the best diffusion of light, protection of parts from damp, and ease and safety in renewing lamps and globes. The principal parts com-

prise a 16-in. copper hood, enamelled white inside to serve as a reflector, with a cover hinged as shown to allow access to the lampholders; a strong removable china box upon which the lampholders are mounted, and a second hinged cover which fits over the china box, thus enclosing all terminals, wires, and lampholders in a completely watertight manner. The reflecting hood is carried on "shadowless" flat oval arms and an ornamental ring, and the globe may be either clear, frosted, or prismatic. The lantern is supplied for either one or two tubular lamps in the one globe. The "Aston" lamps have already been adopted by the District Councils of Dartford, Epsom, and Sutton-Coldfield, and the Borough of Southwark. They have only been on the market a few weeks. They form the subject of a new illustrated list which the firm has just issued.

Bankruptcy Proceedings. — Henry Sclater & Co., electric light and power engineers, Torphichen Street, Edinburgh, and Henry Sclater, electrical engineer there, the sole partner of said firm, as such partner, and as an individual, were to be examined in the Sheriff Court House, Edinburgh, on Tuesday last.

Last week in London Charles Bright, electrical engineer, Buenos Ayres and London, appealed from a receiving order in bankruptcy made by Mr. Registrar Giffard. The Court dismissed the appeal.

Liquidation. — Creditors of the Electric Insulation Syndicate, Limited, are to send particulars of debts, &c., to Mr. G. R. Fraser, 31, Copthall Avenue, E.C., liquidator, by December 16th.

Books Received.—"Water-tube Boilers," by Leslie S. Robertson. London: John Murray. 1901. 8s. net.

"Instruments et Méthodes de Mésures Electriques Industrielles," by N. Armagnat. Paris: C. Naud. 1902 (*sic*).

Electrical Illuminations.—On his Majesty's birthday a number of electric illuminating devices were executed on the E.L.B. system, a notable scheme being the entire decoration of the Grosvenor Mansions, which have some 200 ft. frontage in Victoria Street. The front was illuminated with festoons and large patriotic devices. Mottoes were also provided for the Drury Lane Theatre, whilst at the Royal Opera House, Covent Garden, where the principal lighting effects for the balls are already installed on the E.L.B. system, special illuminations were provided which were lit up at midnight of Friday's ball, so as to herald November 9th.

We have received from Mr. P. Humphreys, resident engineer of the Isle of Thanet Power Station, a sample of the "Acme" lamp, which he has devised for temporary lighting, &c. The lamp itself is of the ordinary b.c. type, with two small terminals soldered to the contact plates; these can readily be attached directly to the ends of the leads, without the necessity of spending time and money on lampholders. The device is very simple and effective. A small rubber cap protects the base of the lamp when used for outdoor work.

Electrical Plant Contracts.—The International Electrical Engineering Company, Liège, of Clun House, have the following contracts in hand:—

One 500-KW. traction steam dynamo with Willans engine for the Dundee Gas Commissioners.

One 300-KW. traction steam dynamo with Belliss engine for the Hull Corporation.

Three three-phase steam alternators with Allen engines, and one three-phase main switchboard for the Erith U.D.C.

Also work for the central stations of Glasgow, Colne, Middleton, Bloemfontein, The Cape Town Electric Lighting Company, Birmingham Tramways Company, &c.

For the British Xylonite Company the company is supplying two 250-KW. three-phase low-speed steam alternators of a new design, the poles being outside the armature; also a main switchboard, and about 30 motors ranging from 3 B.H.P. to 120 B.H.P., with all necessary controlling switches. The engines will be by Easton and Co., on the Schmidt superheated steam system.

One 100-KW. low-speed continuous current fly-wheel type dynamo, and six motors ranging from 5 B.H.P. to 18 B.H.P., also specially designed electrical travelling block, are being made for Messrs. J. & E. Hall, Limited, of Dartford.

For the Bahia Blanca and North-Western Railway Company (to the order of Messrs. Mordey & Dawbarn), four electric capstans have been specially designed with revolving table, so that all the mechanism can be readily examined; also 20 motors ranging from 5 to 25 B.H.P., complete with controllers for driving cranes, traverser, capstans, &c.

For Messrs. Stevenson's Yard at Hebburn-on-Tyne (to the order of Messrs. Warren, Beattie & Co., Middlesbrough), 39 continuous current motors ranging from 5 B.H.P. to 60 B.H.P., each complete with controlling switch, are being supplied.

Ten continuous current motors ranging from 1 B.H.P. to 12 B.H.P., complete with starting switches, are being supplied to the Scottish Co-operative Society, Glasgow and Leith.

The Liége works of the company have many large contracts in hand.

Fire.—A fire which occurred at the United Alkali Company's works, at Widnes, on Saturday night, is estimated to have caused damage amounting to over £15,000.

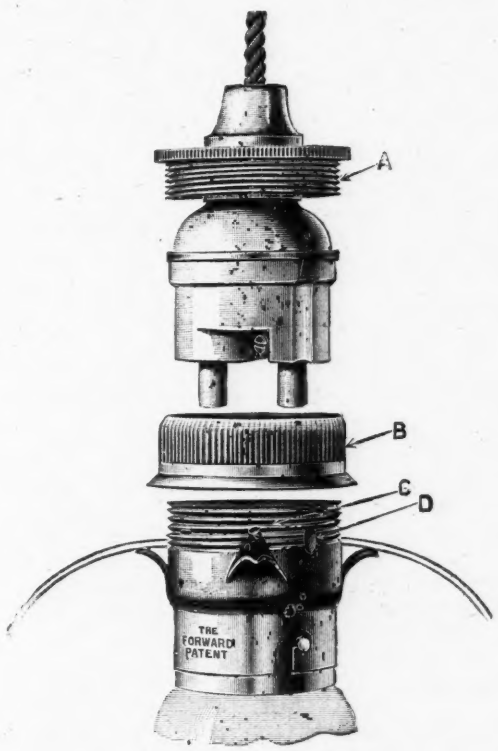
Gas Famine.—One result of last week's fog was a partial breakdown in the gas supply of the East End. In one district of Mile End there was quite a gas famine, and as the electric light has not yet penetrated to that dreary suburb, and oil lamps are not generally used, many shopkeepers had to resort to candles.

Engineers-in-Charge.—The secretary of the Association of Engineers-in-Charge has sent us a copy of the sessional programme. We note that arrangements have been made for an electrical course between October and April. The programme also includes the following items:—

November 13th.—Paper by T. W. Baker, Esq., A.M.I.E.E., A.M.I.C.E., on "Economy in the Production and Use of Steam."
January 8th, 1902.—Paper by Ed. C. de Segundo, Esq., A.M.I.C.E., on "Notes on the Behaviour of Wrought-Iron, Cast-Iron and Steel, under Transverse Strains."
March 12th.—Paper by W. Crawford, Esq., on "High Speed Engines."
April 9th.—Paper by Mr. W. Hollamby, (Member) on "Self-Propelled Road Vehicles."

Leigh Cable Works.—The Anchor Cable Works, Leigh, are now completed, and electric cable manufacturing will shortly commence on a large scale. A sum of £15,000 has been expended on buildings and £20,000 on plant.

New Lampholder.—Mr. A. H. Hunt, of 59, Gresham Street, E.C., is about to introduce a new lampholder to the market. Its leading object is to overcome the difficulties at present experienced in fixing or removing the shades. In small shades it is necessary to have a special tool to fix the shade to the holder, and several appliances have been patented for facilitating the fixing of the shade to the present type of holder. The "Forward" holder has been designed to obviate the necessity of any tools; any shade, no matter how small, can be fitted without any trouble; and, moreover, the actual fixing of the shade on the liner is done in the hands, and not at an awkward height above the head, or possibly on the top of a pair of steps or a ladder. We understand that the



holder is of English manufacture entirely, and can be obtained from Mr. Hunt or any other wholesale electrical house. To fix the shade the top ring, A, and the shade ring, B, have to be unscrewed; the screwed end of the liner, C, is then inserted through the shade and pressed up inside with one finger. Ring B is replaced with the flanged end against the shade, and has to slide back over the insulator, care being exercised so that the two projections, D, fit into grooves in the insulator. The top ring, A, is then screwed down into the shade ring, B. Mr. Hunt is also agent for the Walsall Electrical Company, Limited, and a circular of their "Paragon" sewing machine motor is now before us.

New Lamps for Old.—The fact that glow lamps so far decline in efficiency and candle-power after long periods of burning, that it is better to replace them with new ones than to continue them in use, has been sufficiently demonstrated in our pages from time to time. The Electric Lamp Regenerating Company, Limited, proposes, however, to clean the blackened bulbs of old lamps, and to reinforce their filaments by depositing carbon thereon, at a trifling cost. We have had some lamps renewed for us in this way, and we can vouch for the fact that they were undoubtedly improved to a remarkable degree; the bulbs, which had been blackened to a very visible extent, were restored to their original brilliancy, and the candle-power was quite satisfactory. We are not acquainted with the details of the process, but in most cases it leaves the bulbs practically unaltered in shape and transparency, although they have

to be opened in order to carry out the treatment. An explanatory pamphlet is issued by the company, whose address is 62, Old Broad Street, E.C.

Oldham v. Waring & Gillow, Limited.—We are informed that this action has now been settled out of Court, defendants handing to Mr. Arthur L. Jacobs, of 301, Euston Road, plaintiffs' solicitor, a written guarantee for the full amounts claimed and paying the sum of £20, agreed amount of plaintiffs' solicitor's costs.

Smoke.—The Central London Railway Company was fined £10 and 20 guineas costs at the West London Police Court on 6th inst. for black smoke nuisance at the generating station at Wood Lane. The company expects to have new boilers in operation in about six weeks' time, burning Welsh coal, and it is thought that smoke nuisance will then be prevented.

Superheated Steam and Lubrication.—A circular recently issued by Messrs. Snowdon, Sons & Co., Limited, draws attention to "Sinol," which, as perhaps its name implies, takes the place of oil in cylinder lubrication. It is a semi-solid lubricant, largely composed of pure graphite, and is used with the company's patent positive action mechanical lubricators. The system has been in use for some time at Wood Lane Works, Hampstead, St. Pancras, and other electricity works, and has given great satisfaction with high pressures and superheat; moreover, as the condensed steam is free from oil, the usual difficulties met with in feeding the boilers from the hot well are entirely obviated. Where oil, however, is preferred, Messrs. Snowdon recommend their S. X. S. cylinder oil for superheated-steam engines. This oil has been tested by the Royal Technical Test Institute, at Charlottenburg, Berlin, and a copy of the certificate which is being circulated by the company, shows that it possesses remarkable qualities of purity, freedom from acids and organic matter, and high flash-point.

Trade Announcements.—Messrs. Schmidt's Superheating Company, Limited, of Westminster, have appointed Messrs. Willcox Bros., of 15, Norfolk Street, Sunderland, as representatives for Northumberland, Durham and Yorkshire, and all inquiries with regard to the application of the Schmidt system to marine, locomotive and portable engines should be addressed to them. They have also appointed the Providence Engineering Works, of Rhode Island, U.S.A., as their representatives for the United States of America, and they have already in hand in their works plants to the extent of over 6,000 H.P. constructed under the Schmidt system.

Mr. G. W. Clarke, "electrical consulting engineer and contractor," has, on account of increased business, opened a showroom and office at 117, Queen Victoria Street, E.C., where a stock of electrical accessories will be kept, and a good selection of fittings on show. Mr. Clarke has secured the contract for the electric lighting of the St. George's Chapel, Fulham, for the Guardians, and also for the lighting of the committee room there.

Tucker's Combustion Apparatus.—A neat apparatus for determining the amount of ash in organic materials is being introduced by Messrs. Baker & Co., of 120, Liberty Street, New York. It consists of a platinum crucible with a close-fitting cover; in this the material to be tested is placed, and the whole is heated in a sand bath. Provision is made for stirring the material, and air is drawn in by means of an aspirator, so that all the products of combustion are removed and the suspended matter caught in a beaker. The details are thoroughly worked out, and the apparatus may well be of use to engineers for testing the ash in coal with ease and accuracy.

ELECTRIC LIGHT AND POWER NOTES.

Aberavon.—The cost of electric lighting in this district has engaged attention, and expert calculations show that at a cost of £9,000 to £10,000, a system could be installed capable of supplying about 4,000 8-C.P. lamps.

Abertillery.—The U.D.C. have resolved to promote a Bill for the supply of electricity, a refuse destructor, &c.

Belfast.—The new Corporation Bill to be promoted in the next Parliamentary session will include power to purchase electric motors for hire and letting.

Berwick.—The T.C. has received a letter from Edmundson's Electric Supply Company stating that they anticipate carrying out the work of installation next year, in order to have the light ready for next winter.

Chadderton.—The D.C. has had an interview with Mr. W. J. H. Herring, general manager of the Lancashire Electric Power Company, who fully explained the position of the company, and their means to supply local authorities with electricity.

Cowdenbeath.—On Saturday last the electric lighting installation, carried out by Messrs. Hunter & Jack, had reached such a stage that the light was turned on by Provost Mungall in presence of the Council and the engineers. The length of the cable is 11,000 yards, and the steam is drawn from the boilers of No. 7 Pit belonging to the Fife Coal Company. There are 200 lamp pillars, and each carries two incandescent lights of 8 or 16 C.P. The cost of the installation will be from £1,800 to £2,000.

Darlington.—The L.G.B. has granted the Corporation the necessary powers to borrow £12,250 for electric lighting purposes.

Ealing.—The report of Mr. B. J. Jenkinson, who was employed by the D.C. to test the comparative results of mechanically stoked and hand-fired boilers, states that the results show a saving of ·25d. per unit of electricity generated in the cost of fuel, in favour of boilers fitted with mechanical stokers, on the old coal contract, and under the new coal contract slightly less saving.

Exeter.—The City Council on Wednesday last week debated for the third time the question of the equipment of the new electricity generating station. The discussion had narrowed itself down to consideration of the rival merits of reciprocating and turbine engines. Councillor Challice moved, as an amendment to the Committee's report (which recommended the acceptance of the British Westinghouse Company's tender), that, in accordance with the advice of Mr. Hammond, the specifications be re-drafted, and that new tenders be invited. During the discussion the town clerk read a letter from the British Westinghouse Company concerning a suggestion that they should incorporate in their tender the tenders of other firms (as sub-tenderers) for some sections of the work. Such a proceeding, the company wrote, would lay them open to severe and just criticism in the engineering world. Councillor Rowe thought it commercially immoral to ask for fresh tenders now that each of the tenderers knew the figures already quoted by the others. The amendment was lost by 23 to 14, and the Committee's report recommending the acceptance of the British Westinghouse Company's tender was adopted. The following rider was added to the report: "That the tender be accepted subject to the draft contract being submitted to an expert to be appointed by the Committee, who shall incorporate into such draft contract such additions or alterations as he may deem advisable for the protection of the Council in order to secure a complete equipment of the station; and further, that the plant be tested at the works at the expense of the contractor, and a second time at the expense of the Council at the expiration of 12 months." The Committee were instructed to prepare an application to the L.G.B. for sanction to borrow a sum not exceeding £65,000 for the works, divided as follows:—Plant, £30,000; buildings, £14,000; mains, £16,000; surveyors' fees, £500; land, £2,800; foundations and railway siding, £1,700.

Guildford.—In reply to the T.C., the Electricity Supply Company have expressed their willingness to sell their undertaking to the Council in connection with the latter's new scheme for a dust destructor.

Hertford.—The town is now provided with electric light, on terms which are said to be more favourable than those in Hackney and Islington, where the works are owned by the Borough Councils. In switching on the light on Monday last week, the Mayor of Hertford paid a high tribute to the promptness and thoroughness with which the North Metropolitan Electric Power Distribution Company had carried out the work, and said that the Corporation were delighted that they had transferred the provisional order to the North Metropolitan Company, which had spared neither time nor money in trying to do everything possible to make the undertaking a credit to the town. He found St. Albans was going to contract with the same company for electric lighting.

Holyhead.—A meeting of ratepayers has sanctioned the proposal of the U.D.C. to obtain a provisional order for lighting the town and locality by electricity.

Hornsey.—The D.C. on Monday decided to advertise for an electrical engineer as clerk of works at a commencing salary of £250 a year, rising to £300 on the appointment being made permanent; and that the price to be charged for private lighting be 6d. a unit for the first 100 hours in each quarter, and 3d. afterwards, and 2½d. for power. An agreement was sealed with the National Electric Free Wiring Company to wire houses and supply fittings to consumers.

Jarrow-on-Tyne.—The Durham County Electrical Power Distribution Company has been empowered to light the borough of Jarrow-on-Tyne with electricity, and has entrusted the work of construction to Messrs. Callender & Co., who have just made a practical commencement.

Leigh.—The B. of T. has granted the D.C. another year in which to take up its prov. order.

Leyland.—The U.D.C. is to apply for a prov. electric lighting order.

Limerick.—The lowest tender for the supply of electric plant for the proposed installation in the city was sent in by Mr. Patrick Dillon, Thomond Gate, the amount for the entire work being £16,289. Other tenders from both sides of the Channel ranged from £16,513 to £19,265. The Corporation decided to refer all the tenders to Mr. Enright for his opinion.

London.—STEPNEY.—The Borough Council is about to take proceedings against the Charing Cross and Strand Electric Lighting Company for undue delay and for the loss occasioned to the frontagers in Mile End Road by opening the street.

BERMONDSEY.—The Borough Council has resolved to provide £1,000 for wiring consumers' premises.

ST. PANCRAS.—As it is now too late to obtain compulsory powers for the purchase of the Harmood Street site for electricity works, the Borough Council has resolved, on the advice of Mr. Baynes, the borough electrical engineer, to carry out extensions at the King's Road works up to 2,200 H.P., at a cost of about £35,000.

Lowestoft.—The Town Clerk has been directed to apply to the L.G.B. for sanction to the borrowing by the Council of £5,743 for electricity extensions.

Manchester.—The fog last week caused a record consumption of electricity in the city. On Wednesday 61,430 units were supplied from Dickenson Street and 14,190 from Bloom Street. The maximum load was 8,100 KW., against a previous record of 6,750 KW. last year. There were sent out from Dickenson Street on Tuesday 60,220 units, and from Bloom Street 7,400 units. On Monday the consumption was 56,460 units from Dickenson Street, and 3,213 units from Bloom Street. The previous record consumption was 48,000 units on the occasion of the heavy fog in the first week of November last year. The new generator at Bloom Street had only been at work for a few days, and is being used exclusively for new consumers, who are now being coupled up as quickly as possible.

Margam.—At the next meeting of the D.C. a motion will be brought forward for the establishment of an electric lighting station for the Port Talbot district, and also of an electric tram system between Taibach and Aberavon. On Monday a resolution was passed to proceed with the application to the L.G.B. to borrow £7,000 for electric lighting. The question of constructing an electric tramway from Taibach to Aberavon was left over.

Newport (Mon.).—After hearing a report by Mr. Parshall, their consulting engineer, upon the present state of the various contracts in connection with the generating station at Newport, the Newport County Council have instructed their town clerk to write to Messrs. Hitchin & Son, contractors for the travelling crane—who were stated to have not yet submitted proper drawings in spite of repeated requests—to the effect that if any loss is caused to the Newport County Council by delay in the completion of their contract a claim for damages will certainly be made against them. It was also resolved to repeat a former and similar warning to Messrs. Morgan & Co., who, Mr. Parshall stated, have not up to the present carried out their work in connection with the foundations sufficiently rapidly to ensure completion in contract time (December 25th prox.). It is still possible for them to complete in time by increasing the number of men employed and providing an adequate supply of materials. The electrical engineer has been instructed to make a return as to the amount of overtime, and the time worked on Sundays, at the electricity works of the Council during the 12 months to September 30th last.

Norwich.—The committee of the T.C. to whom was delegated the duty of negotiating with the local electricity company for the purchase of its undertaking, has resolved to recommend the Corporation to pay £214,000. This outlay will give the shareholders £19 for each £10 share, and the directors will receive compensation to the amount of £5,000; the Corporation will also provide £2,000 for back dividends.

Penarth.—The electric lighting system has been completed, and the plant and mains have been approved by the B. of T. At the power station there are two of the Brush Company's 50-KW. direct driven dynamos, with Universal engines. It is a continuous current system, with a voltage of 230.

Portsmouth.—A L.G.B. inspector held an inquiry on the 7th inst. into an application by the T.C. to borrow £23,000 for electric lighting purposes. The amount was to provide for expenditure that would have to be met within the next three years. Evidence was given by Mr. E. Price, engineer of the electric lighting works. There was no opposition.

Provisional Orders.—The following applications for provisional electric lighting orders are listed in the *London Gazette*:—Edmonton U.D.C.; Frinton-on-Sea and District E.L. and Power Company, 6, Old Jewry, E.C.; Thornaby-on-Tees Corporation; Woolwich Borough Council; Stoke Newington Borough Council.

Rangoon.—Some time ago the Government of India appointed a Committee to report on the question of lighting the city of Rangoon with electricity. The Committee now recommends the invitation of tenders for the erection of power houses for the electric lighting of the public streets, Government offices, and Port Trust properties, and for the laying and equipping of electric tramways throughout the city on a concession of 21 years. Altogether, says *Commercial Intelligence*, this is a contract which will be worth securing, and British contractors must be early in the field with plans and estimates. There should be no chance of a repetition of the Goktiek Bridge incident.

Rhyl.—The new electric light and refuse destructor works were formally opened on Friday last. The works have cost £30,000. Current is distributed for lighting on the three-wire system, giving a pressure of 230 volts at consumers' terminals. About 2,000 8-C.P. lamps have been connected, and 56 12-ampere 16-hour arc lamps. About 16 miles of cables have been laid in creosoted troughs run in with bitumen.

Runcorn.—Sir John Brunner, M.P., and Mr. Posnett have offered £50 each towards the cost of providing an electrical installation at the Runcorn Technical Institute for the purpose of electrical experimental work.

Sunderland.—The Tramways Committee of the Corporation has approached the Lighting Committee, in whose hands is the control of the electrical energy supply, to see if the latter body will reduce the price of energy supplied to the tramways. The present price charged is 2d. per unit, and the Tramways Committee points to other towns where the charge is from 1½d. to ¾d. The Lighting Committee urges that energy cannot be supplied at any such price on a profitable basis, and has declined to modify its terms pending certain inquiries as to the price charged at other places.

Sheffield.—The Electric Light Committee is seeking power to include the following provision in any Bill to be promoted by the Corporation, viz.:—"Notwithstanding anything contained in the Electric Lighting Acts, 1882 and 1888, a person shall not be entitled to demand from the Corporation a supply of electrical energy to premises having a separate supply, unless such person shall have previously agreed to pay to the Corporation such minimum annual sum as will give to the Corporation a reasonable return on the capital expenditure and other standing charges incurred by the Corporation to meet the possible maximum demand of such person." This is similar to the clause adopted by the Liverpool Corporation.

The Finance Committee has considered the proposal of the Electric Light Committee to raise £500,000 for future extensions of the department. The City Council has already authorised application to the L.G.B. for sanction to the loan, but directed that the application be not proceeded with until the matter had been before the Consultative Committee. Mr. Fedden in his report said that if all the plant provided for in the estimated expenditure is installed within the time stated, there will be a plant capacity of 5,000 KW. to 6,000 KW., with stand-by plant of 3,000 KW. After considerable discussion the Consultative Committee approved of the proposed expenditure.

Next Tuesday Mr. A. A. G. Malet, inspector under the L.G.B., will hold an inquiry into the City Council's application to borrow £500,000.

Lye.—The governing body has made very good terms for electric lighting with the Midland Electric Corporation for Power Distribution, Limited. The work is to be commenced at once.

Walker.—During the session of 1899 the Walker and Wallsend Union Gas Company introduced a Bill into Parliament to empower them to supply electrical energy in their gas area, which consisted of Walker, two other urban districts, and one rural district. The Walker Council did not approve the Bill so far as their district was concerned, and applied for a provisional order, which was granted. The Council entered into an agreement with the Newcastle-on-Tyne Electric Supply Company to execute the necessary works, and to take upon themselves during 10 years the whole of the duties, obligations, and liabilities for the supply of electric energy within the Council's district. These works were being proceeded with as quickly as possible, but although Walker was struck out of the gas company's Bill, the gas company had laid two sets of mains in the district, introducing into Walker energy from the adjoining neighbourhood. The Walker Council, therefore, has taken steps to obtain an injunction to prevent the gas company from sending the supply of energy outside their electrical area into the Walker district.

Westminster.—The Westminster Electric Supply Corporation, Limited, gives notice that from the end of the present year the rate of charge for electric energy for power purposes will be reduced to half the lighting rate, and will be as follows:—For the first 4,000 units used in each year 3d. per unit; for all units in excess of 4,000, 2d. per unit. These rates are subject to a discount of 8 per cent.

Weybridge.—The Urban Electric Supply Company, to which Edmundson's Electricity Corporation have transferred their prov. order, have commenced to erect works at Weybridge. The initial installation will provide for 10,000 8-C.P. lamps, but provision is made to meet a possible demand for 80,000 lamps. It is expected to commence supplying current by Easter, 1902, all the plant being well advanced, although possession of the site was not obtained till the 1st. inst. The charges will be on the maximum demand system, at 7d. and 4d. per unit. Mr. W. H. Watts, who has been in charge of important stations controlled by Edmundson's, has been appointed resident engineer. A scheme is being prepared by which small householders can rent lamps and fittings at 1s. 6d. per lamp per annum.

York.—The E.L. Committee recommends that the salary of Mr. A. J. Beckett, mains superintendent, be increased from £110 to £130 per annum.

Slough.—The U.D.C. has resolved to apply for a prov. order for the district of Slough and the parish of Datchet.

ELECTRIC TRACTION NOTES.

Bath.—The B. of T. has confirmed the Bath and District Light Railways Order 1901.

Bilston.—At a special meeting of the U.D.C. last week letters were read from the British Electric Traction Company with reference to the tramways. One requested permission to lay the track along the side of the road to the Red Lion. This was agreed to. The other recommended that the Council should not insist on the paving of Church Street and other streets

opposite schools and places of worship with wooden blocks, as they would be dangerous to vehicular traffic. Several members pointed out the danger to horse traffic by the wooden paving becoming slippery in wet weather. It was decided to release the company from that part of the undertaking.

Barnsley.—The B.E.T. Company has informed the T.C. that the tramways are in hand, and will be opened for public traffic in August, 1902.

Birkdale.—The work of reconstructing the Birkdale tramway for electric traction has begun.

Brighton.—The B. of T. inspected three sections of the electric tram system last week.

Cheltenham.—The Tramways Committee reports having made satisfactory arrangements for the working of the present electric tram system, and for its extension to Chorlton Kings.

Cheriton.—The D.C. is considering its position in regard to its electric lighting and tramways provisional orders, and how to deal with them.

Clacton.—There is a project on foot for an electrical light railway from Clacton to St. Osyth.

Crossbank.—The Council has approached the Lees D.C. with a view to making joint application for a tramway provisional order for these districts, but Lees Council have told the Crossbank people that they were committed to Oldham, and that if they joined with Crossbank it would mean losing 12 months, and also increased expenditure, as Lees has gone through all the preliminaries for the obtaining of the necessary order to allow Oldham to run trams in its district.

Dudley.—Dudley T.C. may join hands with Rowley Regis D.C. in applying for a prov. order for a light railway from Dudley to Blackheath.

Dublin.—The adjourned meeting of the promoters of the proposed Dublin to Navan electric tramway was held in Dublin on Thursday last week. Mr. Nevins made a statement as to the feasibility and cost of the scheme. He expressed his willingness to arrange for building the line if he could get a guarantee for £100,000. Mr. Nevins estimated the cost of building the line at £160,000, but Mr. Frazer, C.E., said the cost of building and electrical equipment would be £250,000. It is proposed to have 12 passenger cars, 40 freight cars, and four heavy motor-cars of 800 H.P. Mr. Nevins also said that he could promise the line from 10,000 to 20,000 tons of trade himself in the year. He intended starting an industry in Navan. No definite decision has yet been come to on the proposed scheme.

Epsom.—The U.D.C. having considered various reports on tramway proposals, have resolved—(1) That as there are no schemes for tramways officially before the Council, it is considered premature to go into the question for the present; and (2) that should any scheme come before the Council, it will be prepared (if possible in conjunction with the Surrey County Council) to oppose such scheme with a view to obtaining proper safeguards for the protection of the interests of the Council and the resident population.

Exeter.—The City Council has been informed by Messrs. Tahourdins and Hitchcock, of Westminster, that they had been instructed by the Electric Tramways Construction and Maintenance Co., Ltd., to apply to Parliament for powers to construct new tramways within the City of Exeter and to certain places beyond the city boundary. The communication was referred to the Tramways Committee to bring up an early report.

Farnham.—The U.D.C. last week had a preliminary discussion on the proposal to connect Farnham and Haslemere by a light electric railway *viâ* Shattermill, Hindhead, Grayshott, and Headley. It was resolved to inform Mr. Clifton Robinson of the various favourable expressions of individual councillors.

Germany.—Newspaper correspondents are referring to the success of the high speed electric railway experiments in Germany. One correspondent says that the speed attained has been 160·2 kilometres, or rather less than 100 miles an hour, and another states it as 105 miles an hour.

Heanor.—The D.C. has received letters with reference to a proposal to apply to the Commissioners for powers to construct a light railway from Derby to Nottingham, through Long Eaton; also from Long Eaton to Alfreton, thus connecting Stapleford, Ilkeston, Heanor, Codnor, Ripley, and Alfreton, and back through Ripley and Eastwood to Nottingham, the lines to be laid on the roads. The Council was not clear whether the letters referred to the same or different schemes, so the clerk is to make further inquiries.

Heywood.—Last Saturday the T.C. decided to apply to the B. of T. for a prov. order under the Tramways Act, to enable the Corporation to acquire the local steam tramway, and to convert the system into one of electricity. The powers of the present tramways company will expire in 1903.

Isle of Man.—An offer to purchase the whole of the undertaking of the Isle of Man Tramway and Electric Power Company, Limited, in liquidation, in the event of the Tynwald Court refusing to sanction the purchase of the horse and cable sections, has been received by the liquidator. An offer for the electric portion of the undertaking alone has also been received.

Melbourne.—A committee appointed by the Legislative Council was sitting last month to take evidence on the subject of electric traction. Mr. Arnot, the Melbourne city electrical engineer, advised the overhead trolley, and that the St. Kilda and Port Melbourne sections should be the first to be equipped.

Mr. Rennick has estimated that the conversion of the suburban railway lines to electric traction would cost £2,500,000.

Merton.—The Parochial Council have ordered their clerk to draw up a report on the subject of local tramways, although, so far, none of the companies with tramway proposals affecting the district have made any official communication.

Middlesex.—From the printed minutes of the Middlesex County Council, it appears that sundry important points affecting tramways have been discussed *in camera*, including the passing of estimates for the proposed light railways: No. 2, for £313,363, and No. 3, for £636,890. The Council has agreed with sundry U.D.C's. affected to widen certain roads; points of difference to be settled by the Board of Trade.

Mitcham.—The U.D.C. is considering the proposals of the County of Surrey Electrical Power Distribution Company to supply current for working tramways under the Council's recently sanctioned light railway order. It is proposed to supply the current from the company's works at Wallington.

Newbiggin.—The Northern Counties Electrical Supply Company has applied to the D.C. for provisional sanction to lay down a tramway system.

Paris.—The Paris correspondent of the *Financial Times* says that not a week passes but in some way or another the affairs of the Compagnie Générale de Traction are thrust upon the notice of the public. The latest story afloat is to the effect that the famous Mr. Rockefeller has arrived in Paris to "save" the company. The rumour of the moment is that Mr. Rockefeller has laid down as a condition for his financial assistance that the whole of the subsidiary concerns shall be handed over to an American syndicate, which undertakes to very considerably reduce the cost of working the East Parisian, North-Western and other Parisian and provincial electric tramcar lines. It is also to entirely reconstruct the Traction Company and provide a Board of Management in which the American element would predominate, Mr. Rockefeller, of course, being the controlling spirit.

Rhondda Valley.—Last week, at the Board of Trade, Mr., now Sir, F. J. S. Hopwood, Permanent Secretary, had before him an application by the British Electric Traction Company, under the Light Railways Act, 1896, for an order confirming the decision of the Light Railways Commissioners in favour of a proposed scheme for a tramway in Glamorganshire from Ton-y-pandy to Porth. Mr. Sydney Morse, solicitor, appeared for the promoters; Mr. Balfour Browne, K.C., and Mr. Rhys Williams opposed on behalf of the Rhondda Urban District Council; and Mr. J. D. Fitzgerald, K.C., opposed for the Taff Vale Railway Company. The *Times* account of the proceedings says that a long argument took place upon the opposition of Mr. Balfour Browne to the preamble. He contended that the Light Railway Commissioners had fallen into a serious mistake, and had misinterpreted the opposition of the Council from beginning to end. He understood that the idea of an appeal to the Board of Trade was that, if there had been a miscarriage by inadvertence or by mistake, they would be able to remedy that mistake. The Council itself intended to go to Parliament with a Bill to make tramways, and at the present time the streets were placarded with notices of such a Bill. The promoters were simply "jumping the claim" of the Council, and taking from them the most important bit of road in the district. Mr. Morse remarked that time after time the company had had their schemes taken from them and their brains had been picked for years. Mr. Fitzgerald, who also opposed the preamble, intimated that if this scheme were rejected and if the local authorities came forward with a more extensive scheme next year, the Taff Vale Railway Company would oppose it in Parliament as vigorously as they did this scheme. Witnesses were called in support of and against the application, and the proceedings lasted the whole day. Mr. Hopwood, at the conclusion of the arguments, said he would consider them carefully and the advice to be given to the Board of Trade. Fortunately, or unfortunately, they were debarred from considering a question of this kind purely from the point of view of the public interest. They could not consider the question merely from the point of view as to whether the light railway would be of public benefit. The Board of Trade had to decide it fettered by the restrictions which had been deliberately put upon them under Section 9, Sub-section 3, of the Light Railways Act, 1896, and it was with that restriction before them and in their minds that they would have to consider the arguments which had been represented to them on both sides.

St. Helens.—The Prescot and St. Helens sections of the St. Helens tramways were opened for traffic on Monday. The Windle and Parr sections have been connected, and there is now a continuous run from St. Helens to Derbyshire Hill, and from Denton's Green to St. Helens Junction.

Wimbledon.—Out of an estimated total of 1,343 ratepayers in North Wimbledon affected by the tramway proposals, no less than 1,160 have signed a petition against their introduction. Every resident around Wimbledon Common is against the scheme. On the contrary, in South Wimbledon, public meetings have been held urging the U.D.C. to provide a tramway system.

(*Continued on page* 807.)

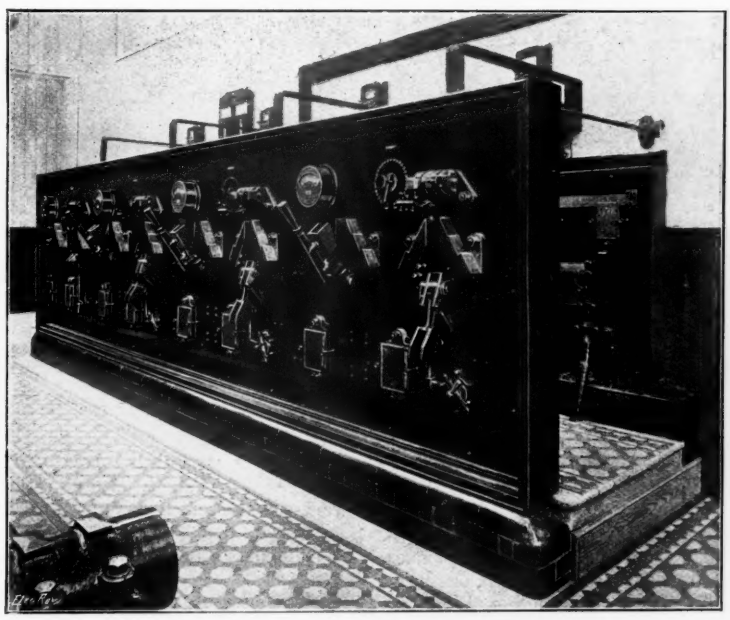
THE POWER PLANT OF THE SILVERTOWN INDIA-RUBBER WORKS.

It is now a considerable number of years since electricity for power and lighting purposes was first introduced into the Silvertown works of the India-Rubber, Gutta-Percha and Telegraph Works Company. The first start was made in 1877, when a small "A" Gramme was put down to drive a mortar mill during the progress of the construction of some of the buildings.

This motor received current from a dynamo of the same size, and at this time there were also several similar dynamos in use for lighting arc lamps in the factory.

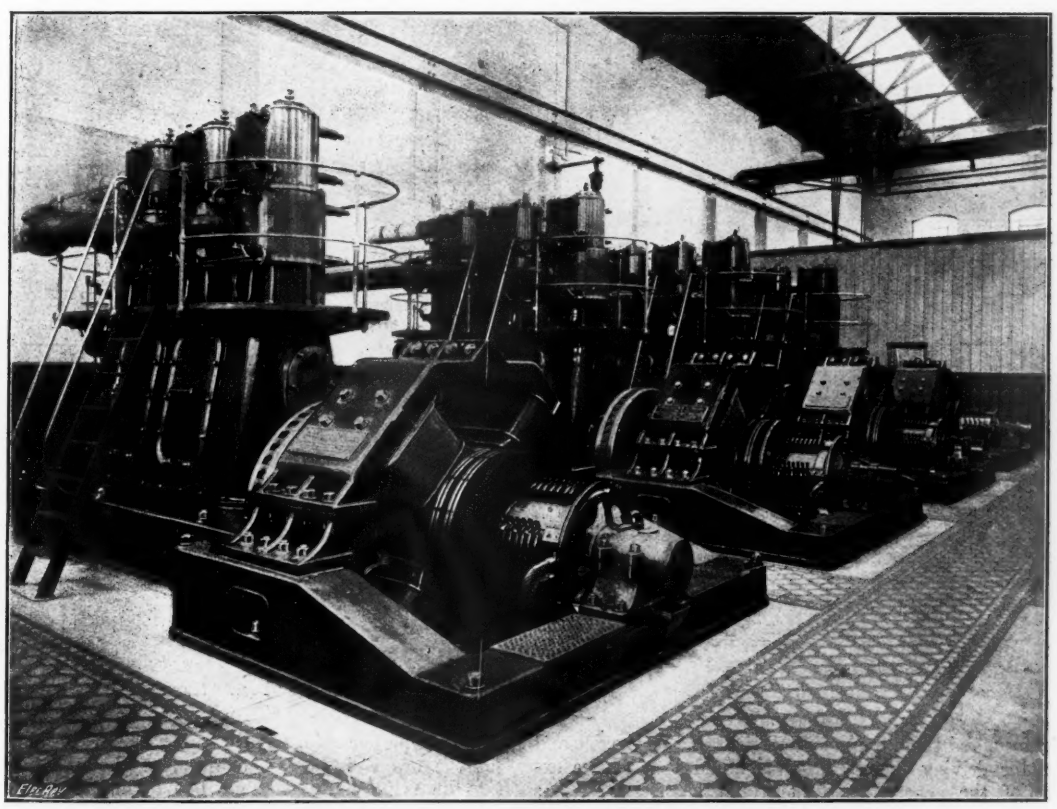
In 1881 the plant was extended by the addition of other machinery for arc lamp lighting, the total H.P. at that time amounting to about 40. A year later, to meet the increased demand for light in the factory, two semi-portable engines, each of 140 I.H.P., were put down, and these drove, through countershafting, 14 dynamos of the flat ring type, supplying current to arc lamps.

When further extensions were required two more engines, each of 200 I.H.P., were installed. These engines were of the open vertical type, running at about 100 revolutions per minute, and drove by ropes on to line shafting, from which a number of dynamos were driven, the largest having a capacity of about 500 16-C.P. lamps.



Main Switchboard.

As time went on this addition to the plant was found insufficient to cope with the increased demand for current, and two 200-H.P. Chandler compound engines running at 340 revolutions per minute were put down, each coupled direct to a Silvertown single horseshoe under type dynamo, supplying



General View of New Engine Room.

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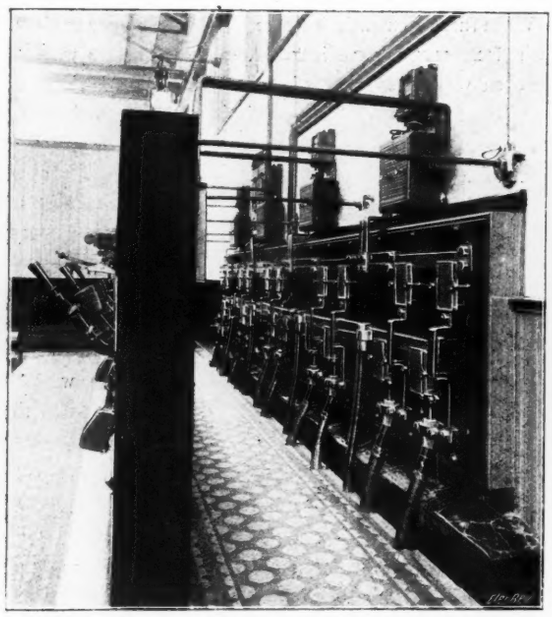
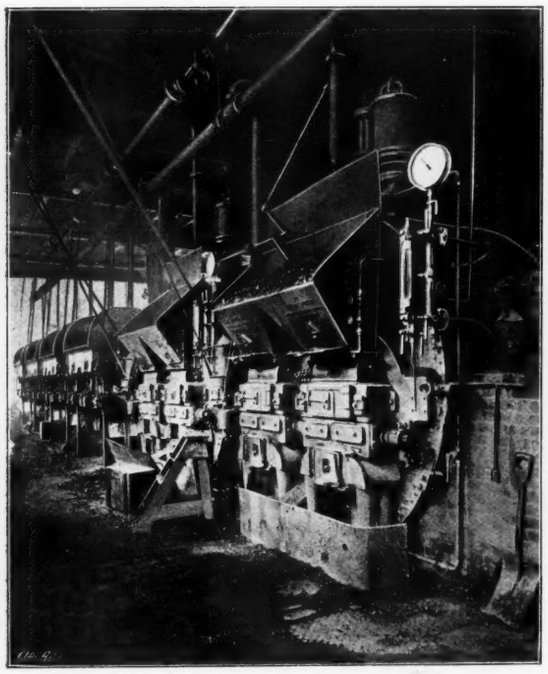
current at 210 volts. A great deal of the arc lighting having in the meantime been replaced by incandescent lamps, the small machines, driven by the vertical engines



Feeder Panels.

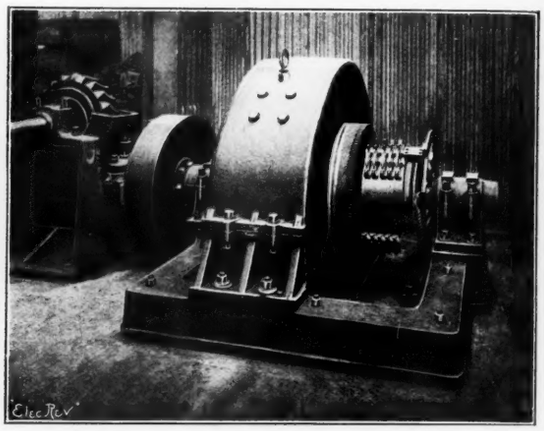
before mentioned, were taken out, and multipolar dynamos, giving 600 amperes at 210 volts, were put down, one being driven by ropes from each of these vertical engines. We give a view of these in the old engine room, which also shows two six-pole traction generators undergoing their full-load tests.

Up to this time there were but very few motors in use in



View of Boiler House.

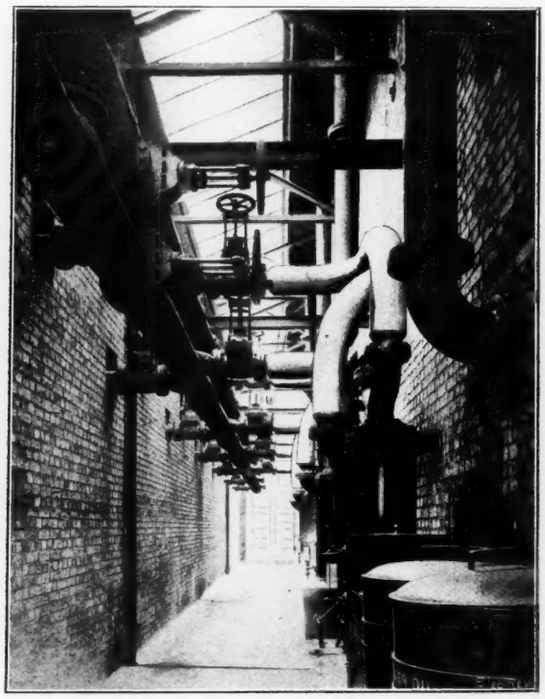
the factory, and those were of small size; but as the demand for motor driving increased, it was found that a large extension of the generating plant would be necessary. As there was no space for further extensions on the site of the original generating plant, a site on the river side of the factory was taken, and new buildings were erected, consisting of a boiler house 130 ft. long, 54 ft. 6 in. wide, and 20 ft. high, with a flat roof, designed for carrying condensers; an engine house 103 ft. long × 35 ft. 6 in. wide and 25 ft. high, fitted with a 15-ton travelling crane; and between the boiler and engine house a pipe alley 130 ft. × 9 ft. wide and 22 ft. high, in which are placed the main



150-h.p. Motor Driving Grinder.

steam pipes, with all the steam valves, steam separators, &c. There is also sufficient space in this pipe alley to instal air pumps and circulating pumps for the condensing plant, when this is added.

The boiler house and pipe alley are not yet finished; but works are now in progress which will complete the boiler house to the projected length of 130 ft., and will also complete the original design, which provides for a chimney stack at each end of the boiler house. At the

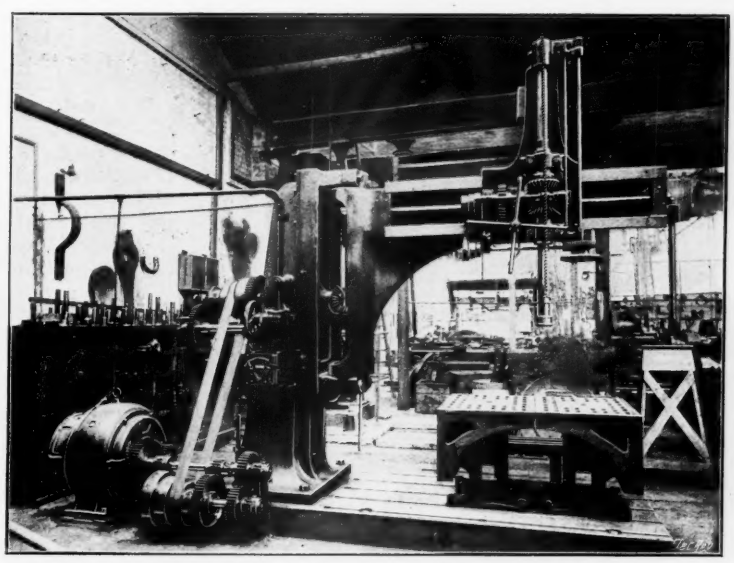


Pipe Alley.

present time one chimney 120 ft. high × 6 ft. inside diameter at the top is in use at one end of the building, whilst at the other end a chimney 140 ft. high × 8 ft. 4 in. inside diameter at the top is in course of construction, this shaft being made larger than the first so as to allow of

an extension of six more boilers than the boiler house as at present projected will contain, in case such extension is found necessary. A space exists in which such a boiler house can be erected, and is well situated for leading the flues direct into the larger chimney stack mentioned above.

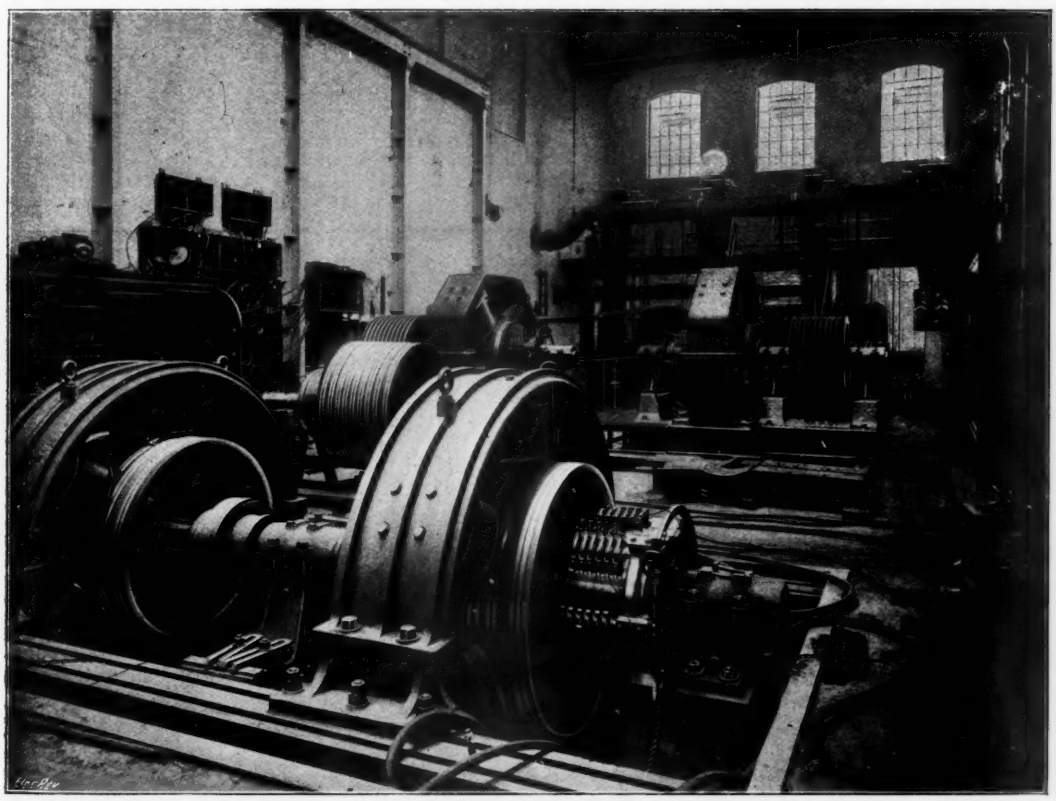
Outside the building is a Wright water softener, in which the feed water, which is taken from the mains, is softened by the lime and caustic soda process. The softened water is stored in an iron tank of 50,000 gallons capacity on the top of the boiler house. The feed pumps are Cameron's quadruple-acting piston pumps, each capable of delivering 7,000 gallons per hour, and the feed water from these pumps can be passed either direct to the boilers, or through a Simoon water heater and Green's economiser of 240 pipes, fitted with automatic motor-driven scrapers.



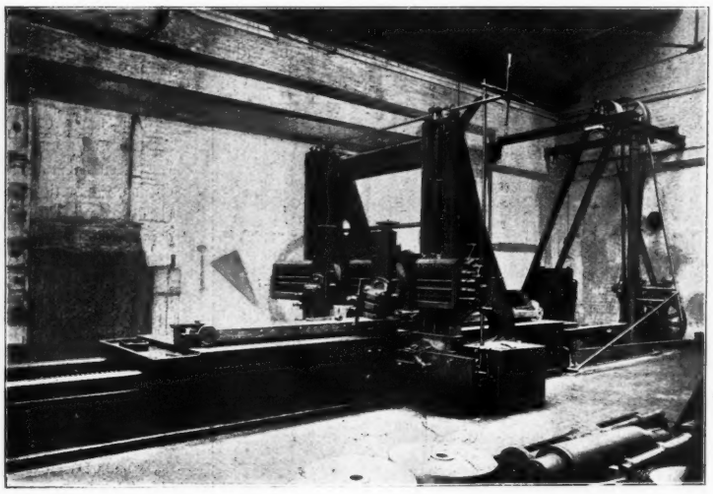
Motor-driven Radial Drill.

When the present boiler house is completed, there will be 10 Lancashire boilers, each 30 ft. long × 8 ft. diameter, fitted with coking stokers, and working at a pressure of 160 lbs. per sq. in., but at present only six of these are installed and in use, with Vicars and Meldrum stokers. A duplicate set of steam pipes of wrought-steel, with flanges welded on, connects the boilers with the engines. All necessary stop valves are arranged in the pipe alley, so that any engine or any boiler can be cut off independently of the others. Hopkinson valves are used.

In the engine room are erected four steam dynamos, each consisting of a three-crank tandem compound Belliss engine of 500 I.H.P., direct coupled to a Silvertown four-pole shunt wound dynamo giving an output of 1,500 amperes at 210 volts, when running at a speed of 350 revolutions per minute. The armatures are of the smooth-core drum type, with carbon brushes. The yoke is divided into four parts, and the poles are bolted on, a special keying device being used to hold them in exactly the right position. The switchboard consists of a series of slate panels, one for each generator, and each panel carries a main hand switch, a minimum automatic cut-out, an ampere-meter and fuses for the generator circuit, together with a regulating switch for the adjustable resistance in the shunt circuit of the dynamos. Behind this switchboard for the generators are the feeder panels, on which are arranged the bus bars and fuses for the feeders which serve the various parts of the factory. A Hookham meter is provided



Old Engine Room and Testing Bed.



Silvertown: Motor-driven Planer.

for each dynamo, and is fixed over the feeder panels. Two large station voltmeters of the Weston illuminated dial type, and an Elliott recording voltmeter, are mounted in a prominent position.

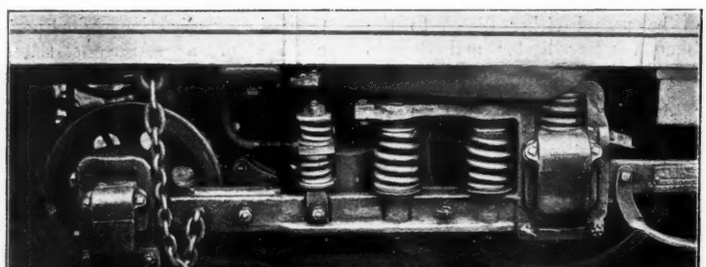
The main cables are of the concentric type, insulated with vulcanised india-rubber and armoured, and they are laid direct in the ground. The feeders are connected in suitable underground junction boxes to ring mains, also consisting of concentric cables laid as above, which traverse the principal roads and alley ways in the factory, and from which branches are taken to distributing boards fixed at convenient places inside the buildings. From these distributing boards separate circuits are run, some for motors and some for lighting, as it is found that so long as the lighting and motor circuits are kept separate after leaving the ring mains, no trouble is caused through fluctuations of the lighting by the frequent stopping and starting of the motors.

The number of motors at present installed is 83, ranging from small motors of 1 H.P. up to motors of 150 H.P. each. They are used for driving machinery for the following purposes, viz.:—

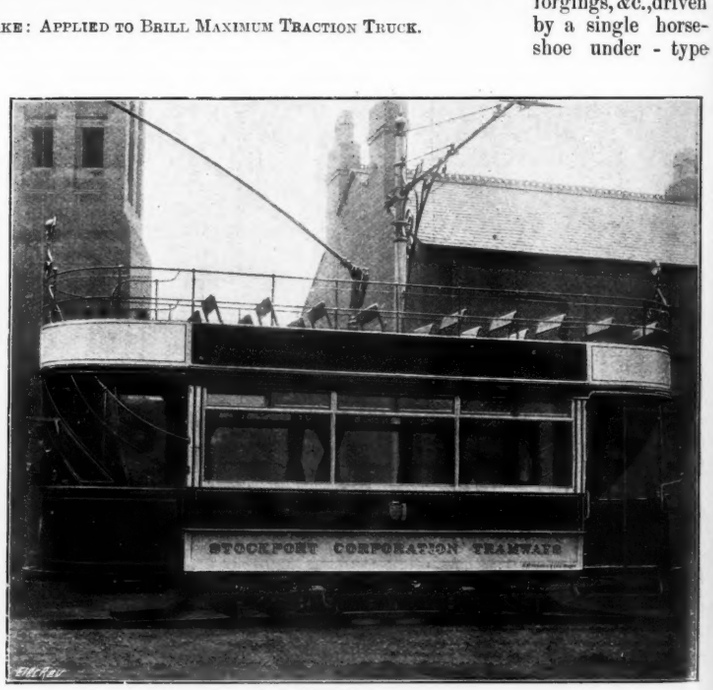
India-rubber washing, grinding, mixing, warming, and callendering; ebonite buffing, glazing, and polishing; cable stranding and winding machines; hydraulic and lead presses; air, oil, hydraulic, and feed pumps; fans and sewing machines; lathes, planing, drilling, and sawing machines; carbon crushing and sieving; refrigerating machines, masticators, conveyors, economiser-scrapers, capstans, cranes, and various other small machinery.

The power required by all these motors, if working simultaneously at full load, would be about 2,000 E.H.P., whilst the lighting of the various shops requires current for 50 arc lamps, and the equivalent of about 14,000 8-C.P. incandescent lamps. Most of the current is supplied from the new generating station; but the smaller stations still exist, and are used whenever necessary. A 24-hours' service is maintained from Monday morning until Saturday afternoon, as at least one of the departments of the factory is generally working a night shift.

The great interest of this installation, which, although for one factory only, is as large as is often provided for a town of 50,000 inhabitants, lies in the diversity of the uses to which the motors are put, each application having formed the object of a special study, and no doubt this experience will largely assist the Silvertown Company in the manufacture and supply of motors and gear for other factories in which they may be engaged to instal their machinery. All the dynamos and motors are of their own design and manufacture, and the illustrations which accompany this article show examples of the most prominent types. In addition to the generating plant, already described, we give illustrations of one or two motor-driven plants of which we were able to obtain photographs. One, on page 804, represents a rubber grinding machine driven through worm gearing by a four-pole slotted core motor, capable of developing 150 B.H.P. when running at a speed of 300 revolutions per minute. The figure on this page represents a planing machine with table 19 ft. × 5 ft., and four tool boxes each carrying two tools, suitable for machining heavy magnet forgings, &c., driven by a single horse-shoe under-type motor. The table has a maximum stroke of 17 ft., effected by means of a large leading screw, which is driven by open and crossed belts. Another view shows a drilling and tapping



Emergency Brake: Applied to Brill Maximum Traction Truck.



Emergency Brake: Single Truck Car Equipped with Brake.

machine capable of tapping a 1½ in. hole in mild steel, driven through gearing by a small four-pole semi-enclosed motor, running at about 500 revolutions per minute.

A NEW EMERGENCY BRAKE FOR ELECTRIC CARS.

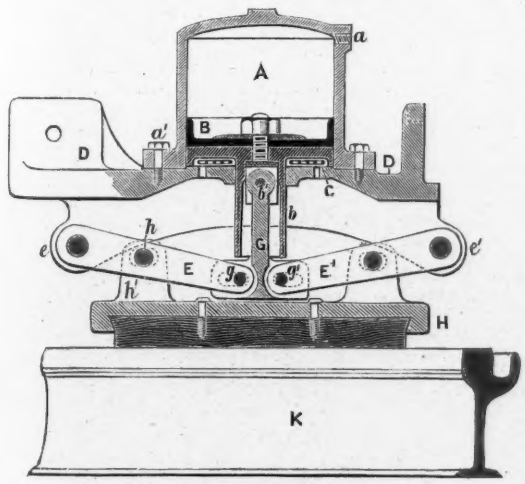
Engineers in charge of the construction of electric tramways have lately had to pay great attention to the brake question. The large number of accidents due to want of sufficient brake power has caused the Board of Trade to take a very decided stand, with the result that they have refused to sanction the opening of some lines until more effective brakes are employed.

A number of fatal accidents have been caused by runaway cars on gradients of a more or less severe character; but by far the greater number of accidents have occurred on perfectly level roads, through passengers or vehicles attempting to cross in front of the cars. A wheel brake in an emergency of this kind has been found quite insufficient. The greater speed and weight of electrically-propelled cars demands a brake which can be capable of instantaneous application, requiring as little physical exertion as possible from the driver, so that his attention is not distracted from his other duties.

A powerful brake instantaneously applied to the wheels simply causes them to skid, not only allowing a runaway car to continue its course down a hill, but also damaging the car by producing flats on the tread of the wheels. It is therefore obvious that an emergency brake, to avoid such mishaps, must act on the track itself, and be entirely independent of the brake on the wheels.

We give below a description of a brake designed by Messrs. Hewitt & Rhodes, consulting electrical tramway engineers, of Manchester, which has proved to be most effective as an emergency brake. The brake acts directly on the rails, and is worked by means of air pressure, procured from a compressor driven from one of the axles of the car.

The accompanying sectional drawing shows clearly the construction of the brake. An air cylinder, A, is carried on a bracket, D, attached to the truck. The piston, B, of the cylinder, is connected by a swinging rod, G, to two levers, E, E′, which have their fulcrums on the bracket at *e* and *e′*. The levers carry the slipper shoe, H, on which is fixed a brake block of oak or beech, which can easily be renewed. Each brake is complete in itself, and can be fixed to any type of



Section of Emergency Brake.

truck. Our illustrations on the previous page show it fixed to a Brill maximum traction truck and to single truck. To each tramcar four brakes are fitted, whether bogie trucks or single trucks are used. On the single trucks better braking is obtained by using four brakes, as the designers found that in going down inclines, when they used two brakes only, a large proportion of the weight of the car was taken by the front wheels, instead of by the front brakes when four are used.

The brakes are applied by means of a handle placed near the hand brake, and above it is a pressure gauge indicating the pressure available for use. A very small effort is necessary to operate the handle.

In this brake the air in the cylinder makes an elastic cushion between the rail and the truck, thus avoiding the violent jolting usually associated with the sudden application of brakes, and the wear and tear on the car caused by a purely mechanical brake is greatly diminished, while in addition increased safety and comfort are ensured to the passengers.

This brake has already been fitted on the cars of the Oldham and Stockport Corporations, and is being adopted on other electric tramlines.

Before the brakes were adopted by the Stockport Corporation, an accident occurred through a car running away on a long steep gradient of that town, although all the brakes on the car were fully applied. A trial has since been made with one of the cars fitted with Messrs. Hewitt and Rhodes's pneumatic slipper brakes on the same hill, the test being made as severe as possible. The car was allowed to attain a speed of about 20 miles an hour before applying the brake, in order to reproduce the conditions of a runaway car. On sudden application of these brakes alone the car was brought to a standstill in a distance of approximately two lengths of the car.

The sole licensees for this brake are Messrs. Estler Bros., London.

ELECTRIC TRACTION NOTES.

(*Continued from page* 802.)

Selby.—Landowners have been considering the feasibility of a light railway to serve the district between Selby and Goole, and to provide accommodation for the Marshland district.

Salford.—The formal opening of the Corporation electric tramways will take place on the 20th inst., it having been arranged that the ceremony should signalise the completion of the Pendleton route.

Smethwick.—An agreement between the Corporation and the B.E.T. Co. for the working of the tramways within the borough has been signed.

Tramway Schemes.—It is stated that Mr. T. Nevins is taking over the Electric Tramway Construction and Maintenance Company, Limited, and its tramway schemes.

Underground Railways.—Among other underground lines in contemplation, says an evening paper, is one from Brompton to Piccadilly, making connection with the District Railway at Charing Cross, and a new line (by arrangement with the Great Northern Railway Co.) from Finsbury Park to the Strand. The latter will run from Finsbury Park through King's Cross to Holborn, then on to the Strand, and will join up with the District Railway at the Temple Station. The scheme will be brought before Parliament in the next Session, and if it is granted the public will be able to travel direct from South Kensington to Finsbury Park. As to the Hampstead-Charing Cross line, Mr. Yerkes says that work has not yet been begun on it, beyond the acquisition of station sites, because of the uncertainty at present existing as to the terminus at the Hampstead end.

Walsall.—On Saturday, at the meeting of the T.C., it was resolved that, providing the South Staffordshire Tramways (Lessee) Company, Limited, agree to take a supply of current from the Corporation works for working the whole of the Bloxwich section of the tramways, including the proposed extension to Bell Lane, until the expiration of their lease for three years, at a price to be settled by the Committee, the Council proceed at once to lay the necessary mains, and to construct the necessary work, at an estimated cost of £6,371 10s, and that additional generating plant, including engine, boiler, dynamo, and condensing plant, be provided at the generating station, at a further estimated cost of £8,800, to meet the probable demand for current for tramway purposes at the end of 1902. It was also decided that, subject to satisfactory arrangements being made with the company for working the extension of the tramways to Bell Lane, Bloxwich, for the remainder of the term of three years, from January 1st last, the Council proceed at once to construct and equip that portion of the line at an estimated cost of £6,000; and also to make such alterations and construct such new works as may be necessary for equipping the whole of the Bloxwich section of the tramways for taking a supply of current from the Corporation works at a further estimated cost of £3,140.

West Bromwich.—The borough surveyor and consulting engineer have now prepared the necessary plans and details for the reconstruction and electrical equipment of the tramways. The permanent way of the whole of the lines within the borough will be entirely relaid with new material, the rails will be of a heavier section than the existing ones, and special care will be taken as regards the construction of the joints. The lines from the Handsworth boundary to Carter's Green and from Carter's Green to Hill Top and to Great Bridge will be double throughout. Several alterations will be made as regards the lines of curbs in Great Bridge and Dudley Road in order to have double lines, and the overhead wires will be carried by centre poles placed every 40 yards apart, which can be used for street lighting. The Spon Lane and Bromford Lane lines will be as at present, single lines with passing places, and will be connected up to the main lines both at Dartmouth Square and St. Michael's Street. The overhead wires will be supported by span wires, the poles being placed opposite each other on the footpaths.

TELEGRAPH AND TELEPHONE NOTES.

Burnley Telephones.—A meeting of representatives of the authorities within the Burnley area has considered the subject of municipal telephones, and has agreed to call in an expert to furnish a report on the proposed scheme, the cost to be borne by the four boroughs represented at the meeting, namely, Burnley, Nelson, Colne and Todmorden.

The Cause of a Cable Interruption.—A fault removed a few months ago from the Eastern Extension Telegraph Company's Sydney—Nelson section at as great a depth as 330 fathoms was found to contain a tooth firmly fixed in the core or interior portion of the cable containing the conductor, although it was protected by the usual sheathing of thick iron wires and outer coverings. An expert examination of the tooth proved it to belong undoubtedly to a shark, the exact variety of which could not be identified. Five species are known to exist at a depth of 300 fathoms, and one as deep as 500 fathoms.

Chatham Telephones.—The meeting of the representatives of Rochester, Gillingham, and Chatham on the subject of local municipal telephones, resolved that inquiries should be made as to the cost of establishing and working municipal telephones, with the object of ascertaining whether they could be obtained with advantage to the three districts.

Combination in the Post Office.—On Monday last, November 11th, the Postmaster-General received a deputation from the Joint Committee of Postal and Telegraph Organisations for the purpose of discussing the present position of the rights of combination among postal employés. Lord Londonderry was accompanied by Sir George Murray, and the deputation consisted of Mr. George Raby, chairman of the joint committee, and Mr. C. H. Garland, a member of the same body. Mr. Raby, in opening the case, said that Mr. Arnold Morley, when Postmaster-General, had said that postal employés enjoyed all the privileges enjoyed by Trades Unionists, the Duke of Norfolk had made the same assertion, and Mr. Hanbury, when representing the Post Office in the House of Commons had declared that "the right of combination was absolute." Far from this being the true state of affairs, it might be said that combinations were not recognised but only tolerated in the Post Office. They were denied the cardinal principle of a free choice of delegates. Mr. Raby read letters from Mr. S. Woods, Parliamentary Secretary to the Trades Union Congress, Mr. W. C. Steadman, L.C.C., Mr. Thos. Burt, M.P., Mr. Fenwick, M.P., and Mr. Sidney Webb, L.C.C., adversely criticising the restrictions placed on Postal Unions. He pleaded that in all collective questions the men should have their chosen representatives freely and frankly recognised. They did not wish to interfere in individual cases or in disciplinary questions. Mr. Garland followed in the same vein, and gave an account of an interview he had with M. Lavy, Chef de Cabinet to M. Millerand, the French Minister of Commerce, on November 5th last. According to M. Lavy, the recognition asked for in England was freely accorded in the French Post Office, and had been found to produce rest and efficiency among the men and considerable advantages to the Department itself. Lord Londonderry said he saw no prospect of departing from the position of his predecessors, but he would inquire into the representations which had been made to him. The deputation then withdrew. The Joint Committee of Postal and Telegraph Organisations represents over 40,000 organised postal workers.

Hull Telephones.—The Corporation has appointed Mr. A. R. Bennett to organise the new telephone department. Over 1,200 subscribers' names have been received in Hull. The estimated cost of the system is £42,000, and Mr. Bennett's remuneration will be 5 per cent. His engagement with Glasgow as general manager expires at the end of two years from the date of his appointment.

Indian Telegraphs.—The *Times* abstracts the Indian Telegraph Administration Report for 1900—1, adding that special interest attaches thereto, since that was the jubilee year of the construction of the first telegraph line in the country, which ran along the Hugli from Calcutta to Diamond Harbour, and, with branches, was 82 miles in length. In 1890—1 the mileage of lines had grown to 37,000, and of wires to 113,000. But, as in the case of railways, the last decade of the nineteenth century saw an unexampled rate of development, and on March 31st last there were over 55,000 miles of line and 182,000 of wire, the increases during the year being 2,146 and 11,130 respectively. The earnings in the 12 months exceeded the previous record by Rs.5,70,000, but the percentage of net revenue on the capital outlay, 6·22, was 1·18 less than in 1897—8, when the revenue from State messages was very great, owing to the military operations on the north-west frontiers. In 1899—1900 the inland private telegram traffic was abnormal, owing to the brisk trade in foodstuffs from comparatively prosperous to famine-stricken tracks; hence the increase in messages of this class in the year under review was less than 1 per cent., and there was a small decrease in value owing to the more extended use of the "deferred" class of telegrams, which are transmitted at half the price of "ordinary," and one-fourth the price of "urgent" messages. The latter class, which has precedence in the order of transmission, was largely resorted to by the Government in connection with the despatch of an Indian contingent to China, and inland State telegrams show an increase of 14·69 % in number and 38·28 per cent. in value. The disturbances in China also contributed materially to the increase of nearly 60,000 in foreign private telegrams, those despatched from Europe to the Far East being transmitted *viâ* Madras; other causes of development were the continuance of military operations in South Africa and the reduction of through rates between Europe and Australia. The total receipts from all sources were, in round figures, 115 lakhs of rupees, which amount exceeded the working expenses by 44 lakhs, or £290,000. The Indian Press urges that some of the surplus should go towards meeting the charges connected with the reduction of the tariff to Europe, but intimate that this desirable reform has been blocked for the present by the action of the German and Russian Governments, through whose territories the wires pass for a few hundred miles. It is understood that the question is to be discussed at the forthcoming International Telegraph Conference to be held in London. The Allahabad *Pioneer* states that both the British and the Indian Governments are prepared to make some sacrifice in the matter, and adds:—"This being so, the opposition of Russia and Germany ought not to be insurmountable, and we should get the half-crown tariff within the next 12 months."

Liverpool and Paris Telegrams.—The Liverpool Chamber of Commerce has been informed by the General Post Office "that a direct wire between Liverpool and Paris was established experimentally on the 1st ult., and that telegrams for all parts of France originating in Liverpool are being divided between the Liverpool—Paris and Liverpool—Havre direct wires, in accordance with the exigencies of the French inland service. The suggestion that telegrams for Switzerland originating in Liverpool should also be sent over the Liverpool—Paris wire shall receive consideration."

Portsmouth Telephones.—Mr. F. H. Tulloch, M.I.C.E., L.G.B. inspector, held an inquiry on Thursday last week into an application from the Town Council to borrow £26,000 in connection with the proposed municipal telephone service. A petition signed by 14,621 ratepayers having been presented against the scheme, the town clerk stated that a 25 years' license had been obtained from the Postmaster-General. The area would be the same as that of the National Telephone Company. The proposed charges would be £5 17s. 6d. for an unlimited service; £3 6s., with a toll of ½d. a call; and another of £2 10s., with a toll of 1d. a call.—Mr. Bennett, engineer to the Corporation, stated that he had been engaged in telephone work for 20 years, and held a similar position at Guernsey, Glasgow (where they had 2,000 subscribers), and Tunbridge Wells. It was proposed to lay underground pipes through the principal streets of Portsmouth in such a way that no point within the borough would be more than a quarter of a mile from a line of pipes. They had arranged to supply 1,240 subscribers, but if the undertaking increased as they expected it would, they could supply 2,000 subscribers without opening the streets again. Up to the present 1,012 instruments had been asked for, several people requiring more than one connection. Twenty or twenty-five instruments would be required for public use. The subscribers were in Portsmouth, Gosport, Fareham, Cosham, Havant, Emsworth, and Westbourne. The switchboards had been specified and tendered for, for 1,280 instruments to be fitted, but they were of such a size that they would take 3,500 without being altered. The tenders for carrying out the work amounted to £18,936 13s., and he had allowed £4,500 for other expenses. The estimated salaries for the operative staff, manager and workmen, would be £2,137 17s. per year, and the fees from subscribers £6,450. Replying to a question, Mr. Bennett said his commission of £1,500 was included in the estimate. This year at Guernsey there would be a very considerable profit, and at Tunbridge Wells the equilibrium was pretty nearly equal between expenses and receipts. A question having been raised as to the results at Glasgow, the inspector said the exchange in that city had only been started two months, and he proposed to disregard evidence given as to that place.—General Webber, R.E., considered the estimates of Mr. Bennett correct, and that the material was of the best.—Mr. G. Cork, J.P., chairman of the Gosport District Council and president of the Portsmouth Chamber of Commerce, gave evidence in favour of the scheme. The inefficiency of the company's service had often been discussed by the Chamber. He was satisfied that there would be no necessity to make any charge on the rates whatever.—Several ratepayers were heard in opposition, and the inquiry was closed. Subsequently the inspector visited the proposed switchroom in the Town Hall.

Sunderland Telephones.—The Highways Committee recommends the T.C. to apply for a license to establish a municipal telephone system in the borough. It is estimated that £23,000

would be required to provide an exchange and plant to supply, say, 1,000 subscribers, as a commencing number. The rents would be £5 per annum for unlimited use, and £3 per annum, plus 1d. per call, for the limited service. These charges, it is expected, would be sufficient to pay the interest and sinking fund on the capital outlay, and still leave a profit.

Salford Telephones.—The T.C. on Wednesday considered the expediency of joining with other local authorities in the Manchester Telephone Exchange area in the promotion of a Bill to constitute a board for the purpose of providing a system of public telephonic communication in the said area.

Telegraph and Telephone Service in the Straits Settlements.—The superintendent of Posts and Telegraphs for the State of Perak reports that telegraphic communication during the year 1900 was greatly affected by the weather, which was the worst he had known for the past seven years. Not only was the weather continuously bad, thunderstorms following one another daily for months together, and frequently more than one in a day, throughout Perak, but the Colony was equally unfortunate with the cables between Penang and Province Wellesley, which were interrupted time after time, resulting in very heavy delay and consequent loss of revenue, both for the Colony and State, as the telegraphing public between Penang and Perak seemed to be very largely on the increase. He states it would certainly seem desirable that something should be done to lessen the number of interruptions of the cables. At the time of writing, he understood that one cable only was working, and that was quite inadequate to carry, with expedition, the whole of the work between Penang on the one side, and Province Wellesley, the Federated States, and Siam on the other. Some protection, similar to that given to the cables between Hong Kong and Kowloon, he thinks is what is required. The telegrams forwarded and received during the year amounted to 800,324, against 573,938 in 1899, and 94,052 in 1890. These figures, however, represent the actual amount of work done at all offices, and include counting the same telegram twice or three times, as retransmission necessitated. The actual number of telegrams received, including service telegrams, was 109,152—number delivered 142,852, against 110,254 and 147,020 for 1899 respectively. The great difference in the number of the telegrams dealt with, and those received, was due to the interruptions referred to. The average time that telegrams took to reach their destination was 41 minutes; the average delay to any single telegram at any office was seven minutes. The system of telephones is principally under the control of the Police Department, but arrangements have been completed for the establishment of telephone exchanges in Larut and Kinta; 84 miles of new lines were added during 1900, making a total of 680 miles of wire, and 365½ miles of poles in the State, exclusive of railway telegraph lines. In regard to the State of Selangor, more than 216,000 telegraphic messages passed over the wires of the State, and brought in a revenue of $18,000, the increase in the number of messages, as compared with 1899, being 19,000, the increase being attributed to the general increase in business and trade. No extension was made in the lines of the State during the year, but one new office was opened. Telephones remained as in 1899, except that arrangements were made for extending the Kuala-Lumpur telephone exchange to country stations and estates, the work to be commenced this year. In the State of Negri Sembilan no new telegraph lines were constructed or offices opened during 1900, all the resources of the department being devoted to improving and renewing the existing lines and offices. Last year only two stations in the State were connected by telephone, but it was hoped that arrangements would shortly be made to connect all stations. No new telegraph offices were opened in the State of Pahang during the year. It is stated that the scientific adviser to the Colonial Office has reported against the introduction of wireless telegraphy, and the great convenience of telegraphic communication between the coast and the Ulu, the British resident states, must be postponed till the heavy cost of an overland line can be justifiably incurred.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899 ..	..
Para-Maranham	March 1, 1900 ..	..
Cayenne-Pinheiro	Oct. 15, 1901 ..	Nov. 2.
Landlines :—		
"*Via* Hanekin" on Persian territory ..	Feb. 24, 1900 ..	..
Pekin-Kalgan	June 14, 1900 ..	..
Maimatchin-Kalgan	June 30, 1900 ..	..
Communication with Baranquilla and Cartagena towns of Venezuela	Dec. 8, 1900 ..	..
"	Oct. 31, 1900 ..	..
Beyond Ashcroft, B.C.	Oct. 29, 1901 ..	..

Telegraph Jubilee.—Wednesday was the jubilee of the electric submarine telegraph, the first cable having been opened between Dover and Calais on November 13th, 1851. It was laid by Mr. T. R. Crampton, when connection between London and Paris was established.

Telegraph Wire Export Trade.—After the feverish activity of the earlier months of the year relatively a quiet state of affairs is at present prevailing in the export trade of this country in telegraph wire and apparatus connected therewith. Returns just issued show that the value of such exports last month amounted to £112,687, as compared with £80,294 in the preceding month, and £114,253 in October, 1900. So far as the year has gone it has been the most active ever recorded in this branch of industry, the shipments during the 10 months' ending October having attained a value of no less than £2,865,839, as contrasted with £2,583,729 in the corresponding period of 1900, and only £1,100,580 in the first 10 months of 1899.

Telephones in Italy.—It is proposed to construct a long-distance telephone line between Venice, Udine, Trieste and Vienna.

United States—Philippine Cable.—Reuter's Albany correspondent says that the Commercial Pacific Cable Company, which has been incorporated to operate the cable between the United States and the Philippines, has filed a certificate increasing its capital to $3,000,000.

West Indian Cables.—The *Standard's* Washington correspondent says that telegraphic connections of the British West Indies are concerned in the decisions of the War Secretary, Mr. Root, that the Western Union Company, under its Spanish Concession, possesses no monopoly of telegraphic transmission between the United States and Cuba, and that the Cuba Submarine Company's concession is valid.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—November 26th. Overhead line work, cables, bonding, &c., for Corporation tramways. See "Official Notices" November 8th.

Amsterdam. — November 18th. Electrical overhead construction, rail bonds, &c, for the City Council. See "Official Notices" October 18th.

Army Contracts.—The Secretary of State for War gives notice that tenders for specific quantities of the undermentioned articles will probably be invited from time to time during the next 12 months, namely :—Acids, Electrical Instruments, Telegraph Cable. See "Official Notices" October 18th.

Barrow-in-Furness. — November 18th. Wiring the new technical school for the Corporation (500 to 600 lamps). Specifications, &c., one guinea, from C. F. Preston, Town Clerk, Town Hall.

Bermondsey.—December 3rd. Arc lamp carbons, india-rubber cables and jointing materials, &c., for the electricity and destructor works. See "Official Notices" to-day.

Boulder City.—November 23rd. The Council invites tenders from manufacturers for the construction of a tramway system, plans and specifications of which are to be seen at the office of the Agent-General, London. See "Official Notices" September 20th.

Brighton.—November 25th. Meters for one year for the Council. See "Official Notices" November 8th.

Bury.—November 18th. 28 electric tramcars for the Tramways Committee. Lacey, Clirehugh & Sillar, engineers.

Cleckheaton. — Lancashire boilers, economiser, condenser, pumps, pipes, and water tank for the electricity works. See "Official Notices" to-day.

Coventry.—November 27th. Triple-expansion low speed engine, 400-KW. alternator and exciter for the electricity works. See "Official Notices" November 8th.

Croydon.—November 18th. Balancer sets and switchboard for the Corporation electricity works. See "Official Notices" November 8th.

Dublin.—November 25th. The D.U. Tramways Co. wants tenders for stores, including car fittings, electrical supplies &c. See "Official Notices" November 1st.

East London (S.A.).—November 26th. Tenders to Mr. R. N. Moir, Town Clerk, for 50-KW. alternator and engine. London agents, Messrs. Dyer & Dyer, Aldermanbury, E.C.

G.E. Railway.—November 22nd. The directors want tenders for stores as per details given in our "Official Notices" November 8th.

Huddersfield. — The borough engineer has submitted plans, specifications, &c., for the completion of the conversion of the remaining sections of tramway in the borough to electric traction in addition to the extension to Honley, two to three miles outside the borough. The Corporation has resolved to invite tenders for the work.

Hull.—November 28th. Six rotary transformers for continuous current transformation, 2,000 volts to 200 volts, 90 KW. each. See "Official Notices" November 1st.

Islington.—November 26th. Arc lamps, columns, and cables for the Council. See "Official Notices" November 1st.

Kirkcaldy.—November 30th. Rolling stock and electrical equipments for the Corporation. See "Official Notices" to-day.

Lancaster.—November 27th. Rails, fishplates, bonds, bonding, overhead equipment, feeder cables, pilot wires, tramcars, &c., for the Corporation tramways. See "Official Notices" November 8th.

Leigh.—November 16th. Triple concentric cables; 12 months' supply for the Corporation. See "Official Notices" November 8th.

Manchester.—November 23rd. The Corporation is inviting tenders for the erection of electricity sub-stations at Levenshulme, Hyde Road (Denton) and Heaton Norris.

Manchester.—December 4th. 12 water-tube boilers and superheaters, economisers, and feed pumps for the electricity department. See "Official Notices" to-day.

Plymouth.—November 23rd. 300 tons of rails, fish-plates, &c., for Corporation tramways. Mr. James Paton, borough engineer.

Poplar.—November 28th. Electric light installation for two public baths and washhouses for the Borough Council. See "Official Notices" to-day.

Poplar.—November 27th. A year's supply of continuous current electricity meters. See "Official Notices" to-day.

Rochdale.—November 20th. A 70 KW. motor generator for Corporation electricity works extension. See "Official Notices" to-day.

Salford.—November 18th. 850 tons of rails, fish-plates, &c., for the tramways. General Manager, Tramways Department, Town Hall.

Sheffield.—November 25th. The Tramways Committee is wanting 400 steel-tired tramcar wheels. Mr. A. L. C. Fell, general manager, Tramway Department, Town Hall.

South Lancashire.—November 25th. Overhead electrical equipment of lines for the S. L. E. T. and Power Company. See "Official Notices" October 25th.

Spain.—December 1st. Tenders to the Spanish Ministry of Posts and Telegraphs in Madrid for the supply of 11 tons of galvanised iron wire 4 mm. in diameter. Particulars from, and tenders to, La Direccion General de Correos y Telegrafos, Madrid.

St. Annes-on-the-Sea.—November 15th. Street mains for the U.D.C. See "Official Notices" November 1st.

Stoke Newington.—November 18th. Electric lighting cables. See "Official Notices" November 8th.

Wallasey.—November 21st. Electric wiring of certain buildings in Seaview Road, Liscard, for the U.D.C. Specifications upon depositing £1 1s. with the electrical engineer, Mr. J. H. Crowther, at his office, Great Float, near Birkenhead.

Woolwich.—November 15th. Electrical instruments for the Council. See "Official Notices" November 1st.

CLOSED.

Huddersfield.—The Corporation have accepted the tender of the British Electric Car Company for two cars, with reversed staircases, and four ordinary cars, at the price of £513 10s. each for ordinary cars, and £7 each extra for cars with reversed staircases.

Leeds.—The Council has given the contract for electrical switch gear at £2,000 to Messrs. Ferranti, Ltd. There was keen competition.

Leyton.—The D.C. has accepted the following tenders:—Davey, Paxman & Co., four boilers, £2,520; Henley's Telegraph Works Company, Limited, cable for No. 5 steam dynamo, £26; Aiton & Co., piping connections for No. 5 steam dynamo, £95; Willans & Robinson, 700-H.P. engine, £2,285.

Lowestoft.—Last week the E.L. Committee recommended that the tender of the British Thomson-Houston Company to supply a 500-KW. set for £4,447 and for alterations to the switchboard at £365 15s., be accepted. The tender of the Johnson-Lundell Company was at a less price, but was received after the date upon which tenders should have been sent in.

London.—The Battersea Borough Council has accepted the tender of the General Electric Company to supply arc lamp carbons at the rate of £7 15s. per 1,000 pairs until April of next year. The tender of Callender's Cable and Construction Company, amounting to £1,470, is recommended for acceptance for the supply of cables, cast-iron troughing and street and other boxes. The consent of the Borough Council has been granted to Messrs. Mather and Platt to sublet a portion of their contract for the supply of condensing plant, pumps and pipes to the Clay Cross Company.

London.—The London County Council on Tuesday decided the contracts for the supply of the continuous current and three-phase plant, required for the generating station to be built at Greenwich, and the temporary station to be erected at Loughborough Junction, in connection with the reconstruction for electric traction of the tramways between Westminster Bridge and Tooting, &c. The following is a list of the tenders submitted for the (A) continuous current plant by 29 firms who sent in alternative offers to the number of 212; and to this is added a list of the tenders for the (B) three-phase plant which was tendered for by 22 firms with alternatives amounting to 160:—

(A.)—Continuous Current Plant.

	Highest tender. £	Lowest tender. £
Allgemeine Elektricitäts Gesellschaft	34,655	26,890
Bergtheil & Young	37,887	30,574
British Schuckert Electric Company	34,012	26,211
British Thomson-Houston Company	34,577	29,385
British Westinghouse Electric and Manufacturing Co.	39,503	29,335
Brown, Boveri & Co.		26,201
Brush Electrical Engineering Company	36,310	31,355
Buckley, S., & Co.	36,172	29,369
Coates, V., & Co.	38,820	37,020
Crompton & Co.	34,726	30,160
Dick, Kerr & Co.	35,064	*25,964
Electric Construction Company	38,279	29,618
Electric Traction Company	35,665	31,764
Electrical Company	34,936	30,266
Fairburn, Lawson, Combe, Barbour, Limited	31,612	29,779
Ferranti, Limited	30,290	26,673
General Electric Company	48,257	31,763
Greenwood & Batley, Limited	33,705	33,271
Helios Electrical Company	29,487	27,211
International Electrical Engineering	31,410	24,525
Lahmeyer Electrical Company	46,269	26,850
Markham & Co.		30,686
Mather & Platt, Limited	36,195	28,977
Parsons, C. A., & Co.		29,589
Siemens Bros. & Co.	50,770	31,385
Stewart, D., & Co.	31,667	28,392
Thames Ironworks, Shipbuilding and Engineering Co.	34,578	33,638
Wallsend Slipway and Engineering Company	35,684	31,699
Witting Brothers & Co.	33,598	29,236

(B.)—Three-Phase Plant.

	Highest tender. £	Lowest tender. £
Allgemeine Elektricitäts Gesellschaft	52,226	40,916
British Schuckert Company	46,369	39,423
British Thomson-Houston Company	55,086	50,931
Ditto (not to specification)		46,215
British Westinghouse Electric and Manufacturing Co.	58,594	49,555
Ditto (not to specification)	52,971	43,931
Brown, Boveri & Co.	51,278	45,647
Brush Electrical Engineering Company		63,259
Ditto (not to specification)		64,569
Buckley, S., & Co.,	48,633	42,127
Dick, Kerr & Co.	55,570	*46,625
Electric Construction Company	61,260	58,175
Electrical Company	48,562	43,956
Ferranti, Limited	55,808	51,048
General Electric Company	60,639	45,425
Helios Electrical Company	41,774	40,095
International Electrical Engineering Company	46,160	38,006
Johnson & Phillips		53,220
Lahmeyer Electrical Company	64,363	45,885
Parsons, C. A., & Co.	49,901	48,481
Siemens Bros. & Co.	63,455	45,725
Stewart D., & Co.	54,041	53,751
Wallsend Shpway and Engineering Company	63,051	45,266
Witting Brothers & Co.	48,660	44,284
Yates & Thom		50,635

The report of the Highways Committee, after mentioning that the tenders had been examined by the consulting engineer for the work, proceeded to remark:—

"We are advised by Dr. Kennedy that there are considerable advantages to be derived, from the point of view of convenience and economy in working, superintendence at the generating station, and in connection with duplicate, or spare, parts of engines, from using exactly the same type of engine for driving both the continuous and three-phase electrical machinery when installed at the same station. On the other hand, the question whether the continuous current and the three-phase generating machinery should be made by the same firm, is one to be determined entirely by the excellence of the design; and the price for which the machinery can be obtained must, of course, also be considered. The tenders have, therefore, been considered in pairs, according to the type of engine proposed for driving the electrical machinery, consisting of (A) the continuous current dynamos, and (B) the three-phase generators; and nine such tenders were selected by Dr. Kennedy, after very exhaustive analysis, for our especial consideration. Of the selected tenders, those of Messrs. Dick, Kerr & Co. in which their electrical generating machinery was proposed to be driven by Ferranti engines, were the most advantageous in both sections (A) and (B). Their tender for the continuous current plant, with the Ferranti engines, amounting to £25,964, is the lowest of any of the tenders which it was possible to recommend the Council to accept; and their tender for the three-phase plant with the same engines, amounting to £46,626, though not the lowest, was in every way acceptable. The two tenders combined gave a lower total price than any two other tenders for electrical plant of both kinds in accordance with the specification, and driven by the same type of engine, and which otherwise appeared satisfactory; and Dr. Kennedy is of opinion, with which we concur, that it is advisable that Messrs. Dick, Kerr & Co.'s tender for each kind of machinery (A) and (B) should be accepted as being the most advantageous to the Council from all points of view. Messrs. Dick, Kerr & Co. undertake to deliver the continuous current plant within 10 months, and the three-phase plant within 18 months from the date of order. The time named is in both cases less than that asked for when the tenders were advertised, and is quite satisfactory, as are also their guarantees as regards the economy and efficiency of the plant. Messrs. Dick, Kerr & Co. propose to sublet (1) to the English Electric Manufacturing Company, Limited, which is a branch of their own firm, the manufacture of the dynamos, generators, and other electric plant; (2) to Messrs. Ferranti, Limited, the manufacture of the large engines; and (3) to Messrs. Bellis and Morcom, Limited, the manufacture of the auxiliary engines. Dr. Kennedy considers that these arrangements may be sanctioned by the Council, and we concur with that opinion.

FORTHCOMING EVENTS.

Friday, November 15th.—At 8 p.m. Electro-Harmonic Society. Ladies' night.

At 3 p.m. Institution of Electrical Engineers (Students' section). Visit to the E.P.S. Co., Millwall.

Saturday, November 16th.—At 3 p.m. Institution of Junior Engineers. Visit to the Standardising Laboratory of the Board of Trade, Standards Department, Westminster.

Tuesday, November 19th.—At 8 p.m. Institution of Electrical Engineers (Glasgow Section). Ordinary general meeting at the Institution of Engineers and Shipbuilders in Scotland, 207, Bath Street, Glasgow. Inaugural address by the chairman elect, Prof. Magnus Maclean, in connection with which Mr. Walter Jamieson will show some experiments in high frequency currents.

Wednesday, November 20th.—Institution of Electrical Engineers (Students' section). Meeting in the library of the Institution. Paper on "Design and Tests of Small Transformers," by Mr. E. Fawssett.

At 8 p.m. Society of Arts. First ordinary meeting. Opening address of the 148th session, by Sir W. H. Preece, K.C.B., F.R.S., chairman of the council.

Thursday, November 21st.—Opening meeting of the Institution of Electrical Engineers.

Friday, November 22nd.—At 5 p.m. Physical Society of London. Special general meeting will be held at the rooms of the Chemical Society, Burlington House.

THE GENERATING MACHINERY FOR THE L.C.C. TRAMWAYS.

As announced on another page, the tender of Messrs. Dick, Kerr & Co. for generating machinery has been accepted by the London County Council for its new tramways.

The tender comprises continuous current generators and three-phase alternators coupled to Ferranti engines; the total value of the machinery is something over £72,000, and is, in consequence, one of the largest orders for electrical plant ever placed in this country. There were 372 tenders received, and, naturally, American and German firms figured prominently among them; it must be particularly gratifying to our countrymen that in this more or less International competition an English firm should have been selected to carry out this important contract.

NOTES.

Institution of Electrical Engineers (Manchester Section).—The following is a list of the arrangements for this section for the 1901—2 Session. The meetings are held at the new Physical Laboratory, Owens College, at 7.30 p.m.:—

November 19th.—C. H. Wordingham, M.I.C.E., M.I.E.E. (chairman). Inaugural Address.

December 17th.—Julius Frith, A.M.I.E.E., and E. H. Lamb, B.Sc. (Vic.), "The Breaking of Shafts in Direct Coupled Units caused by Oscillations set up at Critical Speeds."

January 14th, 1902.—Bertram Blount. "Electric Furnaces."

January 28th.—Hardman A. Earle, M.I.C.E., M.I.E.E. "Supply of Electricity in Bulk."

February 11th.—C. E. Stromeyer, M.I.C.E. "Steam Boilers."

February 18th.—R. W. Clothier, A.M.I.E.E. "The Construction of English and Foreign H.-T. Central Station Switch Gear."

February 25th.—James Swinburne, M.I.C.E. "Electrolysis."

March 11th.—W. G. Rhodes, M.Sc., M.I.E.E. "Electric Tram Cars and their Equipment."

March 25th.—A. C. Eborall, M.I.E.E. "Modern Practice in Polyphase Plant for Power Work."

April 8th.—A. R. Bellamy, M.I.E.E. "Large Gas Engines for Driving Electric Generators."

April 15th.—G. E. Fletcher, M.I.E.E. "The Treatment and Use of Air Core Cables."

Probable:—Lecture and demonstration, "Wireless Telegraphy," after Christmas.

Liverpool Engineering Society.—Mr. Arthur C. Musker, president-elect of this Society, gave the inaugural address of the new session on Wednesday last week. Mr. Musker's subject was the "Utilisation of Waste Products." In the course of it he referred to the carbon found in the retorts of gas works, which, though mere refuse, had, he said, been found most suitable for use as anodes in the electrolytic cell, and was now sold at several pounds a ton for the purpose. He also instanced the derivation of power from a destructor plant for the lighting of town areas with electricity.

Electromobile Manufacturers.—A meeting of manufacturers and sellers of electric motor-cars is to be held at the Automobile Club, Whitehall Court, on Wednesday next, the 20th inst., to discuss the question as to whether any trials shall be organised in 1902, and what form they shall take.

Electric Omnibuses for New York City.—Within a week or two the New York Electric Vehicle Transportation Company expects to have eight electric stages in service in Fifth Avenue, running between Bleecker and Eighty-Eighth Streets. The present horse stages will be withdrawn. The company expected to have the new stages for use before this time, but there has been delay in their construction. One of the smaller electric stages is completed, and "the seven others like it contracted for will be ready within four weeks." The stages will accommodate 12 persons inside and five passengers on top, in addition to the driver. There are also being built two large "double-deckers," which will have seating capacity for 34 persons. The company has had two electric stages running in Fifth Avenue between Eighty-Eighth Street and 135th Street since January 1st. As the business develops the number of stages on that part of the route will be increased. The *Electrical World* says that the new electric stage already completed is a great improvement over the antiquated horse stage. It is much wider than the old vehicle. The roof is high enough to permit a tall man to stand erect.

An American View of Europe.—The *Electrical World* remarks that "it is interesting and encouraging to note that while certain countries in Europe who are our best customers for mechanical and electrical apparatus are suffering severely from trade depression, the demand for such goods still continues brisk. Indeed, it may be questioned whether the need for economy in production due to lower prices does not of itself act as a stimulus to the purchase of better labour-saving machinery. In the meantime, it can be affirmed without fear of contradiction that no one here views with pleasure the distress existing in some parts of Europe, notably Germany. On selfish grounds alone a return to prosperity is to be desired, for it is hard to conceive of an America long prosperous while Europe, its best customer, has lost purchasing power. A better understanding and a fuller reciprocity are the needs of the hour in our international trade, and it is a hopeful sign of the time that a reciprocity convention will be held in Washington this month under the auspices of the important American Manufacturers' Association."

Re-winding a 5,000-H.P. Armature.—In the *Electrical World* Mr. Arthur B Weeks illustrates a 5,000-H.P. armature at the power house of the Niagara Falls Power Company, which was recently re-wound in five days, breaking all previous records. A force of 10 men was required, working day and night (a double shift of 10 men each) to complete the re-winding of this gigantic armature. To heat the soldering irons, of which a great number were used, a very ingenious method was employed. A small motor was belted to a blacksmith's forge, in which charcoal was burned—a great improvement over the former method of using gasoline soldering pots. In recognition of the services rendered by the men employed on the re-winding, Mr. Paul M. Lincoln, electrical engineer of the company, tendered them a dinner at a local hotel, and divided among them the additional bonus of $50 above their regular wages.

Electromobile Trials.—Glancing over the list of entries for the Automobile Club's run to Southsea on Saturday, the 16th inst., we notice that among the long string of cars entered are two electrical vehicles by Mr. Theodore Chambers, of the British and Foreign Electrical Vehicle Company, Limited. We trust that the enterprise thus shown will meet with its due reward. The distance to be covered is just upon 100 miles, so that it will be a feather in the company's cap if the two electrical vehicles succeed in getting through on one charge, as they hope they will.

Institution of Electrical Engineers (Newcastle Section).—The second annual dinner of the Newcastle-on-Tyne centre of the Institution of Electrical Engineers was held on the 6th inst. at the County Hotel, Newcastle. Mr. J. F. C. Snell, borough electrical engineer of Sunderland, presided over about a hundred guests. Mr. Vesey-Brown proposed the toast of the evening "The Institution of Electrical Engineers," and speaking of electric traction, commented on the fact that prominent officials of the North Eastern Railway Company were prosecuting inquiries in America as to what was their mode of dealing with goods traffic. Mr. Langdon the president of the Institution, in acknowledging the toast, said the field for electrical engineers was, he thought, one of the greatest ever presented to any profession. It was utterly impossible to conceive the extent to which electricity might enter into the conveniences of everyday life. We were entering upon a new phase of competition with other countries. The contest would, no doubt, be a severe one, and there could be no question but that electricity would play a very important part in economic production. It was to be regretted that in England electrical engineers had not been able to make more progress than they had. If England was to successfully compete in other countries, they must place at her disposal all the means in their power as electrical engineers. Other toasts were honoured.

Ferranti v. B.T.H. Co.—This case opened before Mr. Justice Swinfen Eady on Wednesday. It is an action claiming an injunction to restrain defendants from infringing patent No. 701 of January 5th, 1887, granted to plaintiff. Plaintiff also claimed an account of profits, damages and delivering up of infringing articles. Mr. Cripps opened the case for plaintiff, and it is proceeding as these pages go to press.

Concert.—A company of upwards of 500 were present at the Avondale Hall, Landor Road, on Monday last week, at a concert held under the auspices of the City and South London Electric Railway Cricket Club.

Obituary.—Those of our readers who have had relations with the buying department at Silvertown of the India-Rubber, Gutta-Percha, and Telegraph Works Company, will regret to learn that Mr. McKinlay died on the 3rd inst. Mr. James McKinlay joined the Silvertown Company in 1867, and for the last 34 years has passed through his hands, or under his supervision, the several millions of money which the company has spent during this period in wages, and in the purchase of raw material. The detail which Mr. McKinlay has had to deal with has been enormous, and many men less robust in physical and intellectual qualities would have succumbed to the strain thrown upon them. He died as he would have desired, in harness, in his 74th year, and has left behind him memories which esteem, respect, and affection will cause to remain among those who have had the privilege of knowing him well.

Glasgow Exhibition.—This exhibition closed last Saturday. The attendance during the run showed a grand total of 11,496,220, double that of the exhibition of 1888. It is said that the profit on the show is £100,000. The loss on the Pan-American Exposition is estimated at £600,000. They have a passion for big things in the States.

Lectures.—At the Royal Victoria Hall, London, a ecture on "Lightning and Other Forms of the Electric Discharge" was delivered on Tuesday last week by Mr. A. W. Porter.

At the Civil and Mechanical Engineers' Society, on the 7th inst., a paper by Mr. B. Pontifex was read, on "Electric Traction."

Röntgen Society.—Last Thursday Mr. Herbert Jackson delivered his presidential address before this society.

For Sale.—The Rathmines U.D.C. offers a 200 amperes, 100 volts dynamo for sale.—Messrs. W. Griffiths & Co. are anxious to sell certain engines and boilers, pumps, &c., which were made for their new works, but are not required, as they are adopting electric motors. — The auction sale of electric lamps and accessories in connection with the liquidation of the New British Incandescent Electrical Lamp Company, Limited, will be conducted by Messrs. Wheatley Kirk, Price & Co., on Tuesday, November 26th. See our advertisement pages for details.

The Islington Electric Railway.—The Islington extension of the City and South London Electric Railway is now completed, and will be opened to passenger traffic on Sunday, 17th inst.

L.B. & S.C. Ry. and Electric Traction.—Yesterday's *Times* says that Major Cardew and Mr. Philip Dawson have been retained by the L.B. & S.C. Ry., as consulting electrical engineers, to advise generally on the subject of electric traction and in connection with electric works on the line.

Appointments Vacant.—A junior demonstrator in electrical engineering and applied physics for the Northampton Institute (£80). A clerk of works is wanted for Hornsey for construction of electricity works buildings and main laying under Mr. Hammond's direction (£250).

The Factory and Workshop Act, 1901.—As this Act comes into operation on the 1st of next January it is time that its provisions were known. The London Chamber of Commerce have issued a report detailing the work of their committee in regard to proposed amendments to the Bill and the way such have been dealt with in the Act. The committee watched the Bill in its various Parliamentary stages, and have introduced, or caused to be introduced, several important amendments. Thus, in respect of out-workers' lists, it was provided that *any* officer of the council might inspect them. This was altered to "*duly authorised*," &c. An "*engineer*" was to examine boilers every *twelve months*. This has been altered to "*competent person*" and *fourteen months*, so as to allow some latitude to cover the press of holiday inspection. A workshop owner was to be deprived of right of appeal from the decision of sanitary authority. Arbitration is still secured to him. This has regard to fire escapes. Not-dangerous trades have been relieved from the necessity of providing meal rooms, so proper in trades where poisonous articles are used. Employers generally are advised to study the text of the Act.

Personal.—Our New York namesake says that Mr. D. Adamson, who is connected with Joseph Adamson & Co., of Hyde, Cheshire, manufacturers of boilers and electrical travelling cranes, is now visiting the United States.

The same contemporary remarks that Profs. S. Mitsuru Kuahara and Hanichi Muraoka, who occupy respectively the Chairs of Chemistry and Physics in the Imperial University, of Kioto, Japan, and who have been spending a few weeks in America, have sailed for Europe to continue their eastward trip around the world.

THE CENTRAL STATION ENGINEER.

Personal.—On Saturday last, at the Osborne Street tramway power station, Hull, Mr. T. Dawson Clothier, the chief tramway assistant, was presented with a large framed photographic group of the employés of the Hull City Tramways Electrical Engineers' Department, on his leaving Hull to take up the appointment of borough electrical engineer to Bootle. Mrs. Clothier was the recipient of a silver photo frame. The presentation was made by Mr. A. S. Barnard, the city electrical engineer.

Mr. Clothier having now taken up his duties as borough electrical engineer to the Bootle Corporation, all correspondence should be addressed to him there in future.

Mr. H. W. Brotherton, late electrical engineer to the Ingleton Electric Light and Power Company, has been appointed chief electrical engineer to Lord Yarborough, of Brocklesby Park, Lincolnshire.

Mr. A. N. Rye, formerly station superintendent at West Ham electricity works, has been appointed resident engineer at Hawick, Scotland, under Messrs. Edmundson's Electricity Company.

Mr. C. F. Love, one of the engineers-in-charge of a shift at West Ham, has been appointed to a similar position as shift engineer at Halifax.

Last month a member of the staff of the electricity department who left the service of the Bradford Corporation to take up an important appointment in London was the recipient of a handsome present from the employés, and on Friday evening last another official, Mr. G. S. Maben, assistant superintendent engineer, was presented with a solid silver tea service subscribed for by members of every section of the Electricity Works Department on the occasion of his approaching marriage, and on his leaving to occupy the post of chief engineer of the electricity works, Wellington, New Zealand. The presentation took place in the presence of a numerous gathering at the Queen's Hall, Mr. William Jones, superintendent engineer, presiding. It was made on behalf of the subscribers by the city electrical engineer, Mr. R. A. Chattock, who testified to the ability Mr. Maben had shown during his stay in Bradford, and while regretting his leaving, congratulated him on his new appointment. Amongst a number of other speakers, all of whom expressed their heartiest good wishes, and testified to the esteem which Mr. Maben had gained, were Mr. Jones, Mr. E. N. Greaves (chief draughtsman), Mr. C. B. Holdsworth (chief clerk and accountant), Mr. J. W. Eastwood (testing superintendent), Mr. Goff, and Mr. W. H. S. Dawson (deputy city surveyor). An excellent musical programme, in which the various members of the staff took part, was gone through.

In consequence of the appointment of Mr. R. W. L. Phillips, deputy city electrical engineer, as borough electrical engineer, Bedford, the following changes have been made in the staff at the Bristol Corporation electricity works:—Mr. H. Herbert Couzens, second assistant engineer, has been appointed deputy city electrical engineer; Mr. J. H. Bolam, third assistant engineer, to be second assistant engineer; and Mr. W. B. Morgan, of Leeds, to be assistant mains engineer.

The second annual dinner of the Brighton Corporation Electricity Works Cricket Club was held on Monday evening at the Unicorn Hotel, Mr. J. Christie presided, and the vice-chair was occupied by Mr. Goodall. After dinner an excellent programme of songs, recitations, and instrumental selections, interspersed with toasts, was carried out.

NEW COMPANIES REGISTERED.

Direct-Action Engine Syndicate, Limited (71,790).—This company was registered on November 5th, with a capital of £14,000 in £1 shares, to adopt an agreement between C. Tuckfield and D. Weston, of the one part, and O. P. Macfarlane (for this company) of the other part, for the acquisition of certain property and rights therein mentioned, and to carry on the business of steam and electric traction and other engine manufacturers, boiler makers, mechanical, electrical, and general engineers, iron, brass and steel founders, wire drawers, makers of motor-propelled cycles and carriages, and motor carriages of every description, and all component parts thereof, suppliers of power of all kinds, &c. The first subscribers (each with one share) are:—C. Tuckfield, 12, Palace Crescent, East Molesey, electrical engineer;

O. P. Macfarlane, Ware, Herts., accountant; D. H. Wiseman, 194, Gresham House, E.C., clerk; E. H. Dock, 194, Gresham House, E.C., cashier; W. J. Payne, 24, Culmore Road, Peckham, S.E., clerk; J. Fitzpatrick, 147, Leadenhall Street, E.C., chartered accountant, and R. G. Wall, 194, Gresham House, E.C., clerk. No initial public issue. The number of directors is not to be less than two nor more than five, the subscribers are to appoint the first; qualification, £100; remuneration 15 per cent. of the net profits, divisible. Registered office, 138, Leadenhall Street, E.C.

SUPPLY STATION ACCOUNTS.

St. Helens Corporation Electricity Accounts.

The output at St. Helens is rapidly approaching a million units, and the traction load is enabling the costs to be reduced in a remarkable manner. By the arrangement with the tramway company, there is an item in the expenses of £281 for repairs to the overhead equipment which is rather unusual, but while the cars are run by the local company, the Corporation maintain the track and all the overhead plant. The change over from alternating to direct current supply also explains an item of £34.

General Statement.

	1899.	1900.	Inc.
Total capital expenditure ...	£69,157	£100,176	£31,019
Number of units sold	320,106	910,736	590,630
No. of 30-watt lamps connected	13,981	21,229	7,248
Maximum load in KW.	410	675	265
Gross revenue	£5,044	£10,850	£5,806
Gross expenditure...	£3,131	£4,814	£1,683
Gross profit	£1,913	£6,036	£4,123
Average price per unit sold ...	3·61d.	2·81d.	−·80d.

The reduction in receipts is explained partly by the lessened charges, and also by the large proportion of the output taken by the traction load. The output was distributed:—

Year.	Private consumers.	Street lamps.	No. of street lamps.	Traction sales.
1898 ...	60,296 ...	4,795 ...	4 ...	—
1899 ...	112,920 ...	25,110 ...	35 ...	182,076
1900 ...	160,298 ...	51,290 ...	— ...	599,042
	100,106 motors.			

The number of consumers connected is 260, and motors 46, of a total H.P. of 200. The price charged for motors is 2d. per unit, and even this is being reduced to 2d. for two hours daily with a follow-on price of 1d.

Revenue Statement.

	1899. Gross.	Per unit.	1900. Gross.	Per unit.	Inc.
Sale of energy	£4,814	3·61d.	£10,654	2·81d.	−·80d.
Meter rents	54	·04d.	90	·02d.	−·02d.
Sale of fittings, hire of motors, &c.	176	·13d.	30	·01d.	−·12d.
Sundry	—	—	76	·02d.	+·02d.
Gross revenue ...	£5,044	3·78d.	£10,850	2·86d.	−·92d.

Probably owing to the extensive use of batteries with Mr. Highfield's reversible booster, the coal item has been still further brought down to almost ½d. Works costs have been improved by nearly ½d. to $\frac{9}{10}$d., and total costs are better by over 1d., coming out at the very low figure of just over 1¼d. The lighting feeder load was 278 KW., and traction 466 KW., or a total of 675 KW., but the respective figures for plant load were 292 KW. and 302 KW., or a total of 504 KW. The load factors came out at 12·7 : 14·7 and 15·4 respectively, but the good use made of the plant is shown by such a figure for the combined lighting and traction loads as 35 per cent.

Cost of Production.

	1899. Gross.	Per unit.	1900. Gross.	Per unit.	Inc.
Coal	£668	·50d.	£1,343	·36d.	−·14d.
Oil, waste, water, and engine room stores.	54	·04d.	195	·05d.	+·01d.
Salaries and wages incurred in generation and distribution.	795	·60d.	7.2	·19d.	−·41d.
Repairs and maintenance of engine, boilers, dynamos, buildings, overhead equipment, and street lamps.	323	·24d.	1,144	.	+·06d.
Works costs	£1,840	1·38d.	£3,394	·90d.	−·48d.
Rent, rates and taxes ..	321	·24d.	415	·11d.	−·13d.
Management expenses. salaries of managing engineer, secretary, clerks, &c.	271	·20d.	542	·14d.	−·06d.
General establishment charges, stationery and printing, law charges and insurance	398	·30d.	373	·10d.	−·20d.
Other expenses: changing from alternating to direct supply, &c.	301	·23d.	90	·02d.	−·21d.
Total costs ...	£3,131	2·35d.	£4,814	1·27d.	−1·08d.

The financial results are good in face of an increase in interest, &c., charges of no less than £2,916, which was amply provided for by the extra gross profit of £4,123, and enabled the net profit of £13 in 1899 to become the very satisfactory figure of £1,220.

Profit Statement.

	1899.	1900.
Interest on loans, overdraft and deposits	£939	£2,153
Sinking fund for repayments	961	2,663
Net profit carried to superannuation fund	2	—
„ „ forward	11	1,220
Gross profit	£1,913	£6,036

CITY NOTES.

Callender's Cable and Construction Company.

An extraordinary general meeting of this company was held at Hamilton House, Victoria Embankment, on Monday, 11th inst., at which the following resolution was unanimously passed:—

1. That the capital of the company be increased to £500,000 by the creation of 200,000 new shares of £5 each, which shall be called ordinary shares, and as from the issue thereof shall in all respects rank *pari passu* with the original shares of the company mentioned in its memorandum of association.
2. That such ordinary shares shall be issued at such times and on such terms and conditions (including payment of a premium) as the directors shall think fit, provided that on any issue thereof they shall be offered to the holders for the time being of the ordinary shares of the company (including the original shares mentioned in the company's memorandum of association and ordinary shares subsequently created) in proportion to the number of ordinary shares held by them. In each case the offer shall be made by notice specifying the number of shares to which the shareholder is entitled, and limiting a time within which the offer, if not accepted, will be deemed to be declined, and, after the expiration of such time, or on receipt of any intimation from the shareholder to whom such notice is given that he declines to accept the shares offered, the directors may dispose of the same to such persons at such price and in such manner as they think beneficial to the company.

Mr. Henry Drake, who presided, said that the circular which accompanied the notice stated that it was proposed to issue 5,000 ordinary shares at £5 each to the ordinary shareholders, and in consequence of the increasing business of the company, it was thought desirable at the same time that they should take powers to increase the capital of the company by 20,000. They would not be issued at present, but if the business required it they would have those to fall back upon. The business was going on increasing in a most satisfactory way. Another reason why they must have more money was that they had the opportunity of buying some land adjacent to their factory, which it was very necessary for them to have. The more business they did the more money was locked up by the corporations as retention money. There was always a certain percentage of the contract price retained in that way, until most frequently a year after the contract had been executed. They proposed to issue those 5,000 shares and allot them to ordinary shareholders at par. That gave £25,000. On the last occasion they increased the capital they created 20,000 extra ordinary shares, of which they allotted 10,000 to the holders of the ordinary shares. The first 20,000 and the subsequent 10,000 rank *pari passu*, and in the allotment of new shares they must be treated alike. They had been advised that the best plan to adopt was to create a fresh lot of shares entirely and afterwards to create 10,000 ordinary shares; that was the object of the resolutions. The ordinary shareholders would have one new share for every six held.

In reply to questions, the Chairman said that the price of issue had been most carefully considered. The shares were not being offered to the British public. The shareholders were the partners in the concern, and he saw no reason why they should not have this bonus. The shares would be issued as wanted, but in regard to the remaining 15,000, the period of issue was quite indefinite.

The meeting closed with a cordial and unanimous vote of thanks to the chairman and board.

The Brush Electrical Engineering Company.—As foreshadowed by his speech at the general meeting of shareholders, held in January last, and in consequence of the pressure of other engagements, Mr. J. B. Braithwaite, junr., has resigned his seat on the board of the Brush Electrical Engineering Company, Limited, Lord Vaux of Harrowden succeeding him as chairman. Mr. Reginald Ryley has been elected a director of the company in place of the late Mr. J. Slater Lewis.

Stock Exchange Notices.—The Committee has ordered the undermentioned securities to be quoted in the Official List:—Cape Electric Tramways, Limited—Further issue of 40,000 shares of £1 each, fully paid, Nos. 400,001 to 440,000. Potteries Electric Traction Company, Limited—Further issue of £95,000 4½ per cent. debenture stock. Application has been made to the committee to

appoint a special settling day in and to grant a quotation to—Central Electric Supply Company, Limited, 4 per cent. guaranteed debenture stock.

Telegraph Manufacturing Company.—Transfer books (ordinary shares) close from 16th to 30th inst. for payment of interim dividend (8 per cent.) for the half-year.

Liverpool Electric Cable Company.—The statutory meeting of this company was held on Thursday, the 7th inst., at the registered offices of the company, Vauxhall Road, Liverpool.

Meetings.—Our reports of the meetings of the West India and Panama Telegraph Company and the Eastern Extension Telegraph Company, held on Wednesday, are crowded out, and will appear next week.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending Nov. 8th were £482; corresponding week last year, £437: increase, £45. Total to date, £22,755; corresponding period last year, £20,223; increase, £2,532. Miles of track open, 8½. Traffic impeded owing to fog.

Blackpool and Fleetwood Tramways.—The receipts for the week ending November 9th were £184; corresponding week last year, £170; increase, £14. Total receipts to date, £19,845; corresponding period last year, £19,257; increase, £588.

Bristol Tramways and Carriage Company.—The receipts for the week ending November 8th were £3,653; corresponding period last year, £2,941; increase, £712.

British Electric Traction Company.—The following returns are issued of the undertakings of this company for the week ending November 8th:—

Company.	Amount £	Comparison with corresponding week of last year. + £	Comparison with corresponding week of last year. — £	No. of weeks.	Aggregate. Amount £	Aggregate. Inc. or Dec. + £	Aggregate. Inc. or Dec. — £
Croydon*	462	190	—	45	14,494	1,052	—
Devonport	394	—	—	20	8,027	—	—
Dudley—Stourbridge	598	82	—	45	29,739	15,533	—
Gateshead	606	—	—	26½	15,594	—	—
Greenock-Pt. Glasgow	207	—	—	5	970	—	—
Hartlepool	211	13	—	45	10,291	1,290	—
Kidderminster	91	—	1	45	5,546	667	—
Merthyr	198	—	—	31	7,978	—	—
Oldham—Ashton	431	—	29	45	22,546	3,196	—
Poole	225	—	—	31	9,161	—	—
Potteries	1,362	148	—	45	62,962	18,728	—
Southport†	126	—	32	45	7,497	—	2,718
South Staffordshire‡	670	—	120	45	34,978	2,396	—
Swansea	398	—	4	45	19 9 8	4,216	—
Taunton	56	—	—	11½	1,057	—	—
Tynemouth	195	—	—	33	9,581	—	—
Wolverhampton Dist.	78	28	—	45	2,933	652	—

* Partly horse. † Reconstructing. ‡ Partly steam.

Central London Railway.—The receipts for the week ending Nov. 9th were £6,974; corresponding week last year, £5,699; increase, £1,275. Total receipts from July 1st (17 weeks), £113,976. Miles open, 6.

City and South London Railway.—The receipts for the week ending Nov. 10th were £2,505; corresponding week last year, £1,848; increase, £657. Total from July 1st to date, £37,170; corresponding period last year, £30,242; increase, £6,928. Miles open, 4¾.

Dover Corporation Tramways.—The receipts for the week ending November 9th were £170 19s. 8d.; corresponding week last year, £185 7s. 7½d.; increase, £14 7s. 11½d. Total to date, £9,931 19s. 6d.; corresponding period last year, £9,429 11s. 8d.; increase, £502 7s. 10d. Miles of track open, 3; Car miles run, 1901, 5,345; 1900, 4,970. Number of cars, 1901, 12; 1900, 11.

Dublin United Tramways Company.—The receipts for the week ending November 8th were as follows:—D.U.T. Co., electric cars, £3,372 12s. 1d.; D.S.D. Co., electric cars, £742 19s. 0d.; total, £4,115 11s. 1d.; corresponding period last year—D.U.T. Co., electric cars, £3,511 3s. 3d.; ditto, horse cars, £28 0s. 5d.; D.S.D. Co., electric cars, £751 12s. 11d.; total, £4,290 16s. 7d.; decrease, £175 5s. 6d.; aggregate to date, £91,733 0s. 11d.; aggregate to date last year, £90,681 4s. 3d.; increase, £1,051 16s. 8d. The mileage worked is 45 miles electrically, as against 43 miles electrically, and two miles by horses, for the corresponding period last year.

Glasgow Corporation Trams.—For the week ending November 9th, 1901, £13,705 17s. 8d., compared with £9,168 2s. 9d. for same period last year. Aggregate since beginning of present financial year, June 1st, 1901, £295,766 4s. 10d., compared with £219,298 0s. 4d. for same period last year.

Liverpool Overhead Railway.—The receipts for the week ending Nov. 10th were £1,890; corresponding week last year, £1,541; decrease, £151. Total from July 1st to date, £30,725; corresponding period last year, £31,996; decrease £1,271. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

With to-night there ended the final 19-day account of the present year, and the Stock Exchange breathes a resigned hope that business may not again be so listless until, at all events, the next one arrives in 1902. There are now two settlements to pass through before Christmas, and, what with dear money and the approach of the holiday season, we are afraid that no particular revival can take place on this side of the New Year, although there are incipient signs of business here and there. In some of the Electrical issues a fair amount of business is doing; the Supply section is almost active in places, and the Railway market is receiving a good deal of attention. Telegraph varieties are quiet; the outstanding feature is a 5 per cent. rise in Commercial Cable, while West India and Panama are also better. The Miscellaneous list presents few items of interest.

Central London Ordinary and Deferred stocks have both spurted 2 per cent., and the quotations begin to assume quite high proportions. As we have pointed out before, the prices may be put up further before the dividend is declared, but if the distribution is to be at the anticipated rate of 4 per cent., there will probably come a decline in price. Central London Deferred is now, in one sense, relatively higher than North-Eastern Consols. Better figures are also made by City and South London stock this week, the stock having been bought upon the opening of the new extension to the Angel on Sunday next. It remains to be seen how the Stock Exchange axiom will work out, which declares that when the City and South London gets to the Angel it will go to the Devil. But we do not think that those who followed last week's suggestion and bought the stock need trouble about the prophecy. Of course, the rise which has taken place is too small to admit of profitable selling at present, but it is likely to be improved upon. There are fresh reports in circulation with reference to the sale of the Baker Street and Waterloo Railway.

The published ambitions of Mr. Yerkes have produced no effect in the Railway Market. District Ordinary is 26¾; Metropolitan Consolidated 73½; Great Northern and City Preferred "A" shares remain at £8 middle. The quotation for Electrical Traction Company shares is nominally 12½.

Electrical Supply shares have had no fogs to swell their receipts this week, but City of London Ordinary are a remarkably good market, and have found buyers over 10. The Preference, however, have yielded ½. Several meetings of the Corporation, which have lately taken place behind closed doors, are said to have been distinctly favourable to the City Company, but the easily-made assertion does not go into details. Westminsters command the middle price of the quotation, but Notting Hill shares are down 10s., upon selling by holders who want to take up their new shares. The price of the latter is 1½ to 2 premium. At the meeting of the ill-fated Hampstead Electric Company on Tuesday, the reconstruction proposals were carried, and those shareholders whose fancy leads them to throw good money after bad, will probably have an opportunity for indulging their taste.

Traction shares display no alteration, but in British Electric the market is kept going by a goodly number of daily orders. Calcutta trams are 12—½, business being done at 12 5/16 this week. By the way, someone takes us to task for having referred to Calcutta Electric shares as Tramways. We admit the soft impeachment, and had noticed it last week, but as the slip was so transparently obvious, we did not consider it worth mentioning. Still, we are glad to have the friendly reminder. Our correspondent wants to know why we do not quote Calcutta Electrics regularly, besides Oxford, Hove, and other such provincials. The reason is simple. Business in these provincial shares is so very limited that to quote the prices every week would be to waste so much space, but the prices are mentioned in this article as a rule about once a month; oftener if any change takes place. Hove Electrics are 7½, Oxfords 5 to 6, and Bournemouth and Poole 12 to 13; Folkestones are 5½. The Preference shares of the last-named are 10, and the Debenture stock 103½. Electric Lighting of Australia Preference are motionless at 4½, and River Plate Electric Light and Traction Debenture stands at 65 nominally. In the London market, South Londons are ¼ off at 2½ and St. James's Preference have shed a fraction.

In the Telegraph department Anglo-American Deferred are ¼ lower, the Preferred stock is one up, and Commercial Cable has risen five points. It is stated, with what amount of truth we cannot tell, that the company is securing the lion's share of the Wall Street to Shorter's Court business. West India and Panama shares are distinctly better on the brightening prospects of the concern, and the payment of the full dividend on the First Preference up to the end of last century. Eastern descriptions record no particular alteration, but Great Northerns are £1 better.

The new issue of Callender's was sanctioned by the shareholders this week, but has to be confirmed by another meeting on November 27th before a market can be firmly established. The Preference shares are easier, but a rise of one has occurred in the Debenture stock. British Westinghouse Preference are hard at 5¼, being bought by reason of the rapidly completing progress of the works, which the market hopes to see opened in the new year. India-Rubber shares have again risen 10s., but Telegraph Manufacturing at 11 are unaffected by the dividend declaration of 8 per cent. Considerable discussion is on foot as to the legality of the Electrolytic Alkali Company's action in offering a commission to shareholders in respect of a new issue, it being contended that such a course is equivalent to offering shares at a discount. Castner-Kellner Alkali are about ⅞, *cum* the 4 per cent. dividend lately announced.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotations Nov. 6th.	Closing Quotation Nov. 13th.	Business done during week ended Nov. 13th, * 1901. Highest.	Lowest.
82 3 10	African Direct Telegraph, 4 % Debs	100	...	...	...	98 —101	98 —101	...	...
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	...	...	...	3½ — 4½	3½ — 4½	...	...
119,700l	Amazon Telegraph 5 % Debs., Nos. 1 to 1,200 Red. ...	100	...	...	...	78 — 83	78 — 83	...	...
£04.720	Anglo-American Telegraph	Stock	£3 9s.	73/6	3½%	52 — 55	52 — 55	...	...
3,097 640	Do. do. 6 % Pref	Stock	6 %	6 %	6 %	97 — 99	98 — 100	99½	97⅝
3,097 640	Do. do. Deferred	Stock	18s. %	£1 7s.	5s. %	9⅜ — 10½	9½ — 10	10 3/16	9½
44,000	Chili Telephone, Nos. 1 to 44,000	5	3 %	4 %	5 %	3½ — 4	3½ — 4	3½	...
13,333,300$	Commercial Cable	$100	8 %	8 %	...	175 —185	180 —190	...	...
1 741 023l	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	100 —102	100 —102	102	100¾
16,000	Cuba Telegraph	10	8 %	7 %	...	5 — 6 xd	5 — 6 xd	5 1/16	...
6,000	Do. 10 % Pref.	10	10 %	...	...	13½ — 14½	13½ — 14½	13½	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3 — 4	3 — 4 xd	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	8½ — 9½	8½ — 9½	...	...
30,000l	Do. do. 4½ % Debs.	50	...	...	...	100 —104 %	100 —104 %	...	...
60,710l	Direct United States Cable	20	3½%	3½%	3¼%	10½ — 11½	10½ — 11½	10 15/16	...
104,300l	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	137 —142	137 —141	139½	137½
1,930,807	Do. 3½ % Pref. Stock	100	...	...	...	94 — 97	94 — 97	95½	...
1,432,268l	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	114 —117	112 —115 xd	116¼	112
300,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	13¾ — 14¼	13¾ — 14¼	14	13 13/16
320,000l	Do. 4 % Deb. Stock	Stock	...	...	...	113 —118	113 —118	...	...
300,000l	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	5¼%	...	100 —103	100 —103	101½	100¼
200,000l	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	101 —104 %	100 —103	...	...
180,227	Globe Telegraph and Trust	10	5½%	5¼%	5¼%	11 — 11¼xd	11 — 11½	11¼	11⅛
180,042	Do. do. 6 % Pref.	10	6 %	...	...	14¾ — 15¼	14¾ - 15¼	14¾	14 13/16
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	...	15 %	29 — 31	29 — 31	29⅛	...
78,000l	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	40 — 44 xd	40 — 44 xd	...	...
100,000l	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	102 —105	102 —105	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	2½%	...	¼ — ½	¼ - ½xd	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	5 %	...	⅝ — 1	⅝ - 1 xd	...	...
590,000	National Telephone, 1 to 590,000	5	6 %	5 %	5 %	4⅛ — 4⅜	4¼ — 4½	4 5/16	4 3/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅜ - 4⅝	4⅝ - 4⅞	4 11/16	4⅝
2,000,000l	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 — 99	96 — 99	96	...
500,000l	Do. 4 % Deb. Stock Red.	100	...	...	4 %	97 - 100	98 - 101	99⅞	98⅝
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	6 %	1/16 — 1 1/16	1/16 - 1 1/16xd	1	...
100,000l	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	100 —103	100 —103	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7 — 8	7 — 8	...	...
3,303	Submarine Cables Trust	Cert.	...	...	...	125 —130	125 —130	...	...
58,000	United River Plate Telephone	5	6 %	7 %	...	4⅜ — 5¼	4⅜ — 5¼	5 3/16	5
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4⅜ — 5⅛	4⅜ — 5⅛	...	...
179,947l	Do. do. 5 % Debs.	Stock	...	...	...	102 —105	103 —106	...	...
155,600	West African Telegraph, 5 % Debs....	100	...	...	...	99 —102	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼ — ¾	¼ — ¾	...	...
150,000l	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	100 —103	100 —103	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	7 %	14½ — 15	14½ - 14⅝	14⅝	14 9/16
75,000l	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	103 —106	103 —106	...	...
348,777l	Do. do. 4 % Deb. Stock Red.	100	...	...	...	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph	10	2 %	8%	...	¼ — ½	⅜ - ⅝	½	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	5 — 6	5½ — 6½	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	3 — 5	3 — 5	...	...
80,000l	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	101 —104	101 —104	...	...

ELECTRICITY SUPPLY COMPANIES.

100,000	Blackheath and Greenwich Dist. Electric Light, Ord. ...	1	...	...	...	⅜ — ⅝	⅜ — ⅝	...	...
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	...	...	...	97 — 102	97 —102	...	...
19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	6 %	7⅜ — 8¼	7⅜ — 8¼	...	...
20,000	Do. do. 7 % Cum. Pref....	5	...	...	...	8¼ — 8⅜	8¼ — 8⅜	...	...
50,000	Charing Cross and Strand Electricity Supply	5	8 %	9 %	9 %	9 — 10	9 — 10	9½	...
50,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5¼ — 5⅜	5¼ — 5⅜	...	...
250,000	Do. do. do. 4% Deb. Stock Red.	100	...	...	...	104 —106	105 —107	...	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	5½%	5 — 5½	5 — 5½	5½	...
150,000l	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	109 —112	109 —112	110⅜	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	6 %	4 %	0 %	9 — 10	9½ - 10½	10 1/16	9 9/16
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	11½ — 12½	11 — 12	11⅛	11½
400,000l	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	122 —127	122 —127	...	...
200,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	...	...	...	—	101 —104	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	4 %	4 %	8½ — 9½	8½ — 9½	8⅞	8⅞
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	12 — 13	12 — 13	12⅝	12
400,000l	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	104 —107	104 —107	105⅛	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	6 %	7 %	5½ — 6	5½ — 6	5⅞	...
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	5½ — 6	5½ — 6	5⅞	...
120,000l	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	105 —108	105 —108	106¼	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	...	...	...	11 — 12	11 — 12	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1½ — 1⅝	1½ — 1⅝	...	...
49,840	Do. do. do. do. 6 % Pref.	5	6 %	...	...	4 — 5	4 — 5	4⅜	...
250,000l	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	96 —100	96 —100	...	...
98,769	Metropolitan Electric Supply, 101 to 62,500	10	5 %	5 %	6 %	13 — 14	13 — 14	13⅜	13½
220,000l	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	113 —116	113 —116	...	...
250,000l	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	96 — 99	96 — 100	97¾	...
8,652	Notting Hill Electric Lighting	10	6 %	7 %	7 %	15½ — 16½	15½ — 16½	15⅝	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15 — 16	15 — 16	15⅜	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½ — 9½	8 — 9	8½	8 5/16
150,000l	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	97 —100	97 —100	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000l	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2½ — 3	2¼ — 2⅜	...	...
109,518	Westminster Electric Supply, Ord.	5	12 %	13 %	10½%	11½ — 12½	11½ — 12½	12⅝	11⅞

* Subject to Founders Shares. † Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation Nov. 6th.	Closing Quotation Nov. 13th.	Business done week ended Nov. 13th, 1901. Highest.	Lowest.
		‡							
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	5 — 6	5 — 6	...	...
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	87 — 91 xd	87 — 91	...	...
62,074	British Electric Traction	10	6 %	8 %	9 %	13⅛ — 14⅛	13⅛ — 14⅛	14⅛	14⅜
90,000	Do. do. 6 % Cum. Pref.	10	...	...	...	11¾ — 12¼	11¾ — 12¼	12 1/16	11 15/16
600,000*l*	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	121 —124	121 —124	122½	...
70,000	British Insulated Wire Ord.	5	15 %	20 %	15 %	8 — 9	8 — 9	8⅛	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5¼ — 5⅜	5¼ — 5⅜	...	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	...	8 %	⅞ — 1	⅞ — 1	...	...
50,000	¶ „ „ „ 6 % Cum. Pref.	£1	...	...	6 %	1 1/16 — 1 1/16	1 1/16 — 1 1/16 xd	...	...
105,731	Brush Elecl. Enging., Ord., 1 to 105,731	2	4 %	5½ %	5 %	1⅝ — 1⅞	1⅝ — 1⅞	1 7/16	...
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	1⅞ — 2⅛	1⅞ — 2⅛	2 1/16	1 15/16
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	102 —105	102 —105	...	...
125,000*l*	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	99 —102	99 —102	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	15 %	16 — 17 xd	16 — 17	16⅝	16
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5⅝ — 6¼	5½ — 6	...	...
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	111 —115	112 —116	110	109¼
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	...	106 —109	108 —111	110¼	107½
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	...	105 —108	105 —108	107¾	...
440,100	Do. do. Def. do.	Stock	...	...	...	105 —108	107 —110	108½	108
855,000	City and South London Railway	Stock	2⅛ %	1⅞ %	1½ %	51 — 54	55 — 58	58	54
47,500	Do. do. Ord. shares Nos. 22,501 to 70,000 ...	10	...	...	...	5 — 5½	5 — 5½	...	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	6 %	7½ %	8 %	3 — 3½	3 — 3½	...	...
100,000*l*	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	100 —105	100 —105	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	2½ %	⅛ — ⅜	⅛ — ⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	2½ %	1½ — 2½	1½ — 2½	...	...
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	80 — 85	80 — 85	...	...
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	84 — 89	84 — 89	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1¾ — 2¼	1¾ — 2¼	2 1/16	...
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390... ...	2	7 %	...	...	2½ — 3	2½ — 3	...	...
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	98 —102	98 —102	...	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	...	...	10 — 10½	10 — 10½	...	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	99 — 102	99 —102	101	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	14 %	15 %	20 %	16 — 17	16 — 17	16⅜	16 7/16
35,000	Do. do. do. 4½ % Pref.	5	...	4½ %	4½ %	5½ — 6	5½ — 6	5⅝	...
50,000*l*	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	112 —116	112 —116	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	22½ — 23½	23 — 24	23 7/16	23⅛
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	100 —103 xd	100 —103	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½ %	3⅜ %	3½ %	5½ — 5¾	5⅞ — 6⅛	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5	...	12⅛ — 12⅜	12⅛ — 12⅜	...	...
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500	10	...	...	...	15½—16½	15½ — 16½	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	...	6 %	19/- to 20/-	... — ...	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	17½ %	37 — 41	37 — 41	40¼	37½
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	... %	...	104 —106	104 —106	...	...
25,000	Telegraph Manufacturing, Ord. Nos. 1 to 25,000	5	8 %	12 %	12 %	10½ — 11½	10½ — 11½	10 15/16	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5½ — 6	5½ — 6	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	91 — 94	91 — 94	93	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 2/—4/-
National Electric Free Wiring, 17/6 paid, ¾—1.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 15½—16.
Do. do. Pref. (£10 pd.), 10⅛—10⅜.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 4 per cent. (October 31st, 1901).

MARKET QUOTATIONS, Wednesday, November 13th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	23/-	23/-	..
a „ Oxalic	per cwt.	33/-	33/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	89/-	89/-	..
a Ammonia, Muriate (crystal) ..	per ton	£38 10	£38 10	..
a „ „ ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£13	£13	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a „ (50/90%)..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£22	£22	..
a Lead, Nitrate	per ton	£24	£24	..
a „ White Sugar	per ton	£81	£81	..
a „ Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	3d.	3¼d.	¼d. dec.
a „ Caustic (75/80%) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£85	£85	..
a Shellac	per cwt.	105/-	105 -	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a „ Crystals	per ton	£8	£8	..
a Bichromate, casks ..	per lb.	2⅞d.	2¾d.	..

METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£148	£148	..
b „ Wire, in ton lots	per ton	£224	£224	..
b „ Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£75 to £125	£75 to £125	..
c Brass (rolled metal 7" to 12") basis	per lb.	7⅞d.	7⅞d.	..
c Tube (brazed)	per lb.	9½d.	9½d.	..
c „ „ (solid drawn) ..	per lb.	8¼d.	8¼d.	..
c „ Wire, basis	per lb.	7⅞d.	7⅞d.	..
c Copper Tubes (brazed) ..	per lb.	10d.	10d.	..
c „ „ (solid drawn) ..	per lb.	10½d.	10½d.	..
g Copper Bars (best selected) ..	per ton	£80	£80	..

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£80	£80	..
g „ Rod	per ton	£80	£80	..
e „ (Electrolytic) Bars ..	per ton	£82	£82	..
e „ „ Sheets ..	per ton	£90	£90	..
e „ „ Rod ..	per ton	£84	£84	..
e „ „ H.C. Wire	per lb.	9⅜d.	9⅜d.	..
f Ebonite Rod	per lb.	8/-	8/-	..
f „ Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	3/6½ to 3/7½	3/6½ to 3/7½	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants) ..	per ton	44/-	44/1½	1½d. dec.
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	50/- to 52/6	50/- to 52/6	..
i „ Wire, galvanised No. 8 ..	per ton	£10	£10	..
g Lead, English Ingot	per ton	£11 10 to £11 12 6	£11 15 to £11 17 6	5s. dec.
g „ „ Sheet	per ton	£13 10	£13 10	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9	£9	..
d Mica (in original cases), small ..	per lb.	8d. to 9d.	8d. to 9d.	..
d „ „ „ medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large ..	per lb.	8/8 to 7/8	8/8 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	1/0½ to 1/8	1/0½ to 1/8	..
p „ rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ „ strip & sheet	per lb.	From 1/8	From 1/8	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	10½d. to 1/0½	10½d. to 1/0½	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15 to £40		..
i „ „ in bars		£58	£58	..
g Tin, block	per ton	£115 to £116	£116 to £117	£1 dec.
g „ foil	per lb.	1/6	1/6	..
n „ wire, Nos. 1 to 16	per lb.	1/7	1/7	..
p White Anti-friction Metals — "White Ant" brand	per ton	£35 to £65	£35 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7d.	7d.	..
j „ 6 lea. Flax	per lb.	5½d.	5½d.	..
j „ 3 ply 10 lbs. Russian ..	per lb.	4 1/32d.	4 1/32d.	..
j „ 10 lbs. Russian, single ..	per lb.	4¼d.	4¼d.	..
j „ 180 lbs. Jute rove	per ton	£10 2 6	£10 5	2s. 6d dec.
k Zinc, Sh's. (Vielle Montagne bnd.)	per ton	£22 10	£22 10	..

Quotations supplied by { *a* Messrs. G. Boor & Co. *b* The British Aluminium Co., Ltd. *c* Messrs. Thos. Bolton & Sons. *d* Messrs. F. Wiggins & Sons. *e* Messrs. Frederick Smith & Co.

Quotations supplied by { *f* India-Rubber, G.-P. and Teleg. Works *g* Messrs. James & Shakspeare. [Co., Ltd. *h* Messrs. Jackson & Till. *i* Messrs. Bolling & Lowe. *j* Messrs. Walter H. Hindley & Co.

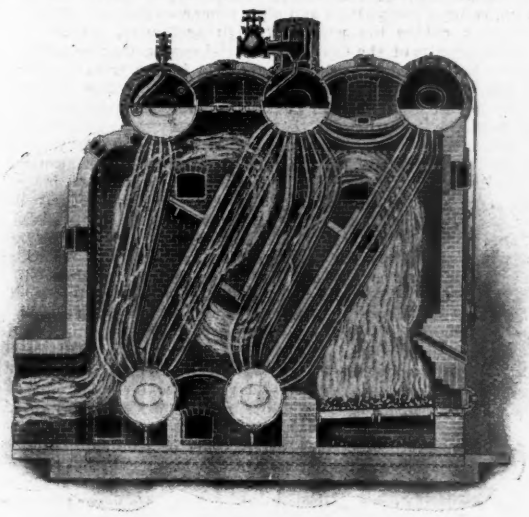
Quotations supplied by { *k* Messrs. Morris Ashby, Limited. *m* Messrs. W. T. Glover & Co., Ltd. *n* Messrs. P. Ormiston & Sons. *o* Messrs. Johnson, Matthey & Co., Ltd. *p* The Phosphor Bronze Company, Ltd.

THE "STIRLING" BOILER.

The search for a boiler which shall, as far as possible, combine the simplicity and reliability of the fire-tube type with the quick-steaming properties and small floor space of the water-tube type has led to the introduction of an enormous variety of designs, most of which, after a brief exposure to the public view, have passed into oblivion. Amongst those which have survived this ordeal, and have established themselves upon a firm footing in central station practice, is the water-tube boiler made by the Stirling Boiler Company, Limited. The business was originally carried on at the company's Albion Road Works, Edinburgh; but, as the boiler grew in favour, it was found necessary to provide larger premises, and new boiler works were laid down at Flemington, near Motherwell. These works are situated at the heart of the coal and steel district of Scotland, about 13 miles from Glasgow, and are on the main line of the Caledonian Railway, from which sidings are run into the works. The latter cover an area of about 10 acres, and are capable of turning out eight complete boilers weekly.

The main shop measures 300 ft. × 150 ft.; it is well lighted and ventilated, and is laid out so as to require the least possible handling of the materials of construction in their conversion from raw to finished products, without overlapping or crossing. Most of the tools are electrically driven; the power house contains two Parsons turbo-dynamos of 130 H.P. each, running at 4,000 revolutions per minute, and provided with the Caledon Shipbuilding Company's surface condensers. There are also two steam-driven 50-H.P. air compressors, of the Ingersoll-Sergeant Drill Company's make, and two hydraulic pumping engines, made by Messrs. Glenfield and Kennedy, working at 1,200 lbs per sq. in. No holes are punched in any part of the boilers; a large number of drilling machines are therefore used, made by Messrs. Buckton, of Leeds. Many of these are of the six-spindle multiple-drilling type. For caulking the seams, pneumatic tools have been supplied by the New Taite-Howard Company. A complete hydraulic plant of modern type has been laid down for stamping drum ends, saddles, &c., out of steel boiler-plate, of which the very best quality is used.

The boiler itself was illustrated in our issue of July 5th, 1901, in connection with our articles on the Glasgow Exhibition; we reproduce a section of the standard boiler of the latest type, having three upper and two lower drums. This pattern is made for evaporations from 2,500 to 21,600 lbs. of water per hour, and for any



Standard Stirling Boiler.

pressure up to 300 lbs. per sq. in. The lower drums are always 3 ft., and the upper drums 3 ft. or 3 ft. 6 in. in diameter, the length varying from 4 ft. 8 in. to nearly 18 ft. The tubes are all 3¼ in. diameter outside, and the largest size contains 432 of them. A special feature of the boiler, on which great stress is laid, is the small floor space occupied, the largest size mentioned taking up an area 21 ft. 3 in. long × 19 ft. 8 in. wide, with a total height of 25 ft., including brickwork.

The large space over the furnace provides for the efficient combustion of the gases, while the long path which they traverse along and amongst the tubes enables the latter to abstract the maximum of heat from them before they enter the flues. The feed water is admitted into the hindmost upper drum; the section of tubes connected with this is to a great extent isolated from the rest of the boiler, so that this section forms what is practically an economiser, and at the same time most of the scale and sediment contained in the water are deposited there. As the lower drums are slung by the tubes from the upper ones, and the whole structure is supported by a steel framing, independent of the brickwork, expansion is allowed to take place freely without the possibility of straining or distorting any part. Lastly, owing to the large water surface and the special steam separator in the dome, the steam is delivered free from priming water to the piping.

A similar boiler of extra large size is made, having four upper and three lower drums, and being capable of evaporating 30,000 lbs. of water per hour.

The boiler is made in a rather simpler form, with a smaller ratio of heating surface to grate area, for use with economisers; as the back section is more completely isolated, this form is also specially useful where the water is exceptionally bad. The standard sizes for this type vary from 3,300 to 9,200 lbs. of water per hour, the last having 252 tubes, and occupying a space 18 ft. 11 in. long × 15 ft. 9 in. wide × 20 ft. high.

Probably the first objection to the boiler which strikes an engineer is the difficulty of replacing tubes. This, however, is more apparent than real. Means of access to every part of the boiler are provided, and we are informed that it is possible to replace practically the least accessible tube well within an hour; should a tube leak or burst, it can be plugged in a few minutes, and left for replacement at a more convenient season. The nearly vertical position of the tubes prevents any accumulation of dust upon them, or of sediment inside them; moreover, the tubes are staggered, so as to break up the streams of hot gases, and the feed water enters the boilers at the coolest part, so that the best conditions for maximum heat utilisation are present.

The circulation is brisk, owing to the large differences in level and the free passages provided; most of the steam is generated in the front banks of tubes, but it is drawn off from the middle drum, so that any priming water given off in the first drum is dropped before the steam arrives at the dome.

Actual experience with the Stirling boilers appears to fully bear out the claims of the makers. The best criterion, of course, is the business done. During the past two years 300 boilers have been sold; of these a large number went to electricity works, including Edinburgh (2,650 H.P.); Brompton and Kensington (2,800 H.P.); Newcastle and district (4,600 H.P.); and on order, London County Council tramways (10,000 H.P.); Eastbourne (1,000 H.P.); Ayr (1,000 H.P.); Kirkcaldy (1,950 H.P.); and Sheffield (1,440 H.P.).

From inquiries which we have made of actual users of the boilers, it appears that they have been in use for several years, with satisfactory results. Scale is mostly deposited in the back tubes, which are easily cleaned. The boiler is an economical steam generator, and can be forced to double its rated output, without producing wet steam, and without an excessive flue-gas temperature.

At one important station no repairs have been necessary in two years, and the boilers are only cleaned once a year, at a cost of about £6 each boiler. It is true that the water supply at this station is very good. The tubes are cleaned by means of a "turbine" cleaner, worked with water at a pressure of 80 lbs. per sq. in., which is said to be very effectual. At this station the average evaporation obtained is 8·6 lbs. from and at 212° F., with coal of 12,800 thermal units per lb., and this is as good as that of the marine boilers at the same station. Chain grate stokers are used, and smokeless combustion is readily obtained, even with smoky coal.

The evaporation mentioned above has been exceeded in tests carried out by Prof. Ewing last year: in these trials over 8,000 lbs. of water were evaporated per hour with natural draught (0·4 in. water) at the rate of 10·03 lbs. water per pound of "Nixon's Navigation" coal, from and at 212° F. The makers guaranteed an evaporation of 6,000 lbs. per hour, which was well within the actual result. Moreover, they guarantee an evaporation of 11 lbs. steam per pound of Welsh coal of 14,500 B.Th.U. calorific value.

It is clear, from what we have said, that the Stirling is a boiler to be reckoned with; it possesses properties and features which render it well adapted for use in electrical generating stations, where it is already finding favour, and we believe that it will, in the future, occupy a prominent place in electrical and general engineering.

THE FUTURE OF THE STEAM TURBINE.

By W. E. WARRILOW.

The advances made in turbine construction naturally give rise to doubts as to the capabilities of the reciprocating engine to hold its own for an extended period for purposes of electric light and power generation, against its rival. A glance at the development of methods of driving the dynamo-electric machine, from its earliest inception to the present time, would show the observer how matters have more or less speedily tended towards the rejection of those types of engine which have occupied considerable floor space in the performance of their duty. The old rope and belt-driven sets, though certainly still running in small stations, very quickly ceased to represent the standard of generating units, their place being speedily filled by the direct coupled plant.

This latter class has passed through many stages, from which it has emerged into two distinct types—the slow and high speed unit. At the outset of electric supply, the engine and dynamo builders occupied positions which were directly in opposition to each other's interests. The engineer could construct a slow speed engine; but the electrician demanded a high speed for his dynamo, so that failing direct coupling, belt or rope gearing was the only compromise which could be effected. The desire for a high speed was not long unfulfilled, so that direct connection between dynamo and engine became possible, until such time as the speed could be reduced for coupling to a slow speed engine, usually of the horizontal class.

In most of the modern stations of average size, the high speed engine has been generally adopted, and it is also to be found in some works of large size, but for schemes which supply electricity to areas of many square miles, there is a tendency to favour the slow speed, or what has lately sprung up, the medium speed unit.

Where ground costs little, the horizontal engine is employed, though even here there is an increasing use of the vertical set to economise floor space. The adoption of this latter course, however

results in an excessive height for the engine house, by reason of the massive proportions to which slow speed machinery attains. This, of course, increases the cost of buildings, as well as the difficulty of handling heavy pieces of metal at a great height; moreover, when repairs are needed, in the majority of cases the engine can only be overhauled by removing the steam chest, cylinders, &c., from the top. Again, the arrangements for steam and exhaust pipings are more complicated and costly, as greater length will be required, and provision for opening and closing valves from the floor level will be necessary.

The increasing size of generating units and stations serves most clearly to illustrate that the reciprocating engine is becoming a giant which may ultimately defeat the object for which it has been raised. The main aim of engineers is, or should be, simplicity in generation, and where possible this simplicity should be attained at all costs. Now, it is evident that the reciprocating engine, though a good and useful power producer, does not represent the ideal in that respect by any means. The great number of its moving parts tends to increase the cost of its attendance and maintenance, items which should be rather the reverse in an electricity station. Again, the time required for the laying of foundations and the erection of the engine militates against the speedy completion of works which may be needed in a hurry, and the majority of stations are usually wanted with the least possible delay. A modern 1,500 kilowatt slow speed set will occupy about 630 sq. ft., while the vertical height will be not less than 22 ft. The foundations for this set will take anything up to three months to build, and the engine and dynamo will not be completed under that time. The horizontal engine will not be considered here, as it is not now laid down in very large stations. The high speed engine does not require very much room, though the height is somewhat excessive, a 1,500-KW. (Willans) set occupying 684 sq. ft., and taking a vertical height of 28 ft. The foundations of this unit will be laid in about six to eight weeks, according to the nature of the ground. Now when these figures are compared with those obtained in pioneer undertakings, it will be seen that the floor space occupied per kilowatt generated has been very materially reduced. In the case of large engines, however, the amount of attendance is not in any way reduced, nor is the cost of the repairs any the less. From the present aspect of affairs there seems very little hope of these items being lowered in cost as long as reciprocating engines are employed, for no matter how little space they may occupy, as long as their upkeep remains at a comparatively high figure, it becomes more evident that further improvement is impossible without alteration in the method of applying the steam.

This change in principle is to be found in the turbine, which, quite apart from any of its so-called defects, represents the ideal engine for the generation of electricity. Possessing but one rotating part and requiring no special foundation, it embodies all that could be desired for coupling to any type of dynamo for direct or alternating current. The improvements effected in its construction and its employment in a large number of electricity works in this or other countries should indicate that it is destined to fill a prominent place in the generating stations of the immediate future. Unlike the early undertakings, the schemes which are now planned demand units having capacities running into thousands of kilowatts, instead of hundreds, so that the class of engine which the turbine represents has every opportunity of appearing to the best advantage, as far as steam consumption is concerned. This question of consumption of steam in lbs. per KW. has been a favourite one with consultants, the makers of engines being encouraged by the offer of a bonus to reduce it as much as possible. The guaranteed performance of a reciprocating engine in this respect has often given it the preference over such an engine as the turbine, though no calculation has been made as to the possibilities of either engine to get out of order, or increase its steam consumption with time.

That the repairs needed for reciprocating engines are always becoming greater with the age of the machine, goes without saying, while consumption of steam will also increase in a corresponding degree. This state of things must continue to exist as long as engines of the reciprocating class are laid down, as no amount of improvements can ever eradicate these defects, which are part and parcel of engines constructed on this principle. Reduction of the steam consumption may be an advantage to a station, but repairs and maintenance are equally, if not more important, especially as the latter cause a want of confidence in the apparatus to spring up, which ultimately ends in disgust. The extensive experience which the engineering world has had of the reciprocating engine for purposes of electric generation, is now making it apparent that the limits to the development of this class of power producer are not far ahead. The contemplation of enormous schemes for the supply of energy from coal pit centres, does not improve the prospect in any way, the thought of maintaining 50,000 H.P. of slow speed vertical engines in repair being far from encouraging, when considered in the light of experience with large stations now running. It is impossible in the limits of this short article to take up all the facts of the case, as an enormous amount of interesting material could be got together on the subject; suffice it to say, that when considered from all points, the reciprocating engine appears in such an unfavourable light compared with a turbine, for large powers, that for electric light and power purposes, it bids fair to yield the palm to its rival.

A modern turbo plant of 1,500 KW. capacity will stand on a floor space of 728 sq. ft., and will have its own condensing plant at that. No foundations are needed for its reception, and no oil is necessary for the lubrication of the rotating parts acted upon by steam. In both these items it will be at once seen that large economies in time and material will be effected. The absence of oil in the steam especially enabling the condensed water to be returned to the boilers. The machine when delivered can be assembled on its particular portion of the engine room floor, and no vibration will take place while the plant is in motion. The appearance of the engine room will also be greatly enhanced, in that the turbo sets occupy little head room, and consequently will cut off little or no light from the windows The small vertical space needed also does much to decrease the cost of buildings as well as the steam and exhaust piping for the turbine. Combined with these are, the little attention required both for running and maintenance, and the ease of manipulation for parallel running on account of the even turning moment.

That the early types of turbine were extravagant in steam is well known, but this circumstance was due to the comparative scarcity of data in the design of such engines, as well as the fact that very small units were required for electric supply purposes.

The day of the small station is, however, about to depart, so that the turbo set can appear to its best advantage under the improved conditions, and where the reciprocating engine must ultimately fail, the turbine can be looked to as a reliable substitute. Such a fact is not one to cause regret on the part of engineers; rather should they welcome the new engine as a means of deliverance from the difficulties which progression on the present lines must assuredly bring. The existing state of competition in all industries, but especially the electrical one, will no doubt keep the reciprocating engine in our midst for some years to come, though the same competition will also bring more prominently to the front the steam turbine, even to the extent of finally ousting its rival.

However, with a reduced steam consumption (such as was obtained with the Elberfeld sets), and with the many other advantages which it possesses, the prospect before the steam turbo-generator is of the brightest, and it remains with consulting engineers to give that fillip to this branch of engineering which it rightly deserves, to land it far ahead of all other methods of obtaining electric light and power from steam.

GERMAN ELECTRICAL FINANCE.

A Record of Decline and Disaster.—The Question of Competition at Ruinous Prices.

General depression in trade, over-production, excessive speculation, ruinous competition and a too numerous creation of mushroom concerns during the period of high prosperity, are the leading characteristics of the German electrical engineering industry at the present time, and it would, perhaps, not be far from the truth to suggest that in these causes lies some of the success of Teutonic firms in securing English contracts during the past year or two. It would be impossible, at the present juncture, to assert definitely whether this is actually the case, but the lapse of another year should show from the reports and balance-sheets of the German companies, at all events by inference, whether the contracts obtained in England have been accepted at prices which have left any margin of profit. Many doubts on this point arise when one finds that Teutonic firms have already begun to incur heavy losses on trading account, apart from the considerable depreciation in the value of electrical securities in which they have become interested. In fact, it is asserted on good authority that contracts have been entered into—not that any particular company or country of destination is specified—entirely regardless of the cost of production, and the statement would appear to be borne out by the financial results of some of the undertakings. It is now proposed, in order to overcome some of the difficulties in regard to orders and prices, to elaborate a scheme to control business and prices, and two of the leading companies are negotiating with a view to arriving at an arrangement in this direction. If this be successful, other prominent firms will be invited to join the movement, but the smaller companies and firms do not regard the scheme with any favour, as they see in it almost a declaration of war. However that may be, our readers will be able to form some idea of the position in Germany from the following summary, which has been brought down to the beginning of November.

The report for 1900—1901 of the Allgemeine Elektricitäts Gesellschaft, of Berlin, the publication of which has been awaited with considerable interest, was issued on October 31st. It states that the turnover has been maintained at the same level as in the previous year, and that most branches of manufacturing have been satisfactorily employed down to the present time. After meeting expenditure, and making provision for depreciation, the sum of £486,921 is available for disposal, as compared with £535,761 a year ago. These figures show that the company has suffered from the decline in the general prosperity, although only in a small degree as compared with other and similar undertakings; and this superiority is due to the fact that its internal affairs have been carefully looked after in times of prosperity. It is proposed at the general meeting in December to recommend the payment of a dividend at the rate of 12 per cent. on the capital of £3,000,000, as compared with the regular payment in the four previous years of 15 per cent. on a less amount of capital. After providing for this distribution, the greater portion of the balance will be transferred to the reserve fund, which will thus reach the legal maximum of £1,500,000, or one-half of the share capital, so that allocations in this respect, to the extent of £75,000 per annum, will perhaps not be necessary in the future. According to a return made to the end of last September, the goods invoiced, and the orders on hand at that time, were practically of the same magnitude as at the corresponding period of 1900, and this position is regarded as satisfactory under existing circumstances, provided that an enduring decline in prices is not brought about by reckless competitors, who

eagerly fight for every large order without any regard to the cost of production. The report then states that a revival in the electrical industry will not take place all at once, but the company is endeavouring to work in the direction of inducing the large undertakings to consider the question of reducing the expenses of testing, manufacturing, and selling, by the introduction of appropriate organisation and distribution of work. In this connection, and as a beginning, preliminary negotiations have been entered into with the Schuckert Company, of Nuremberg, and although no definite decision on the question appears to have been arrived at as yet, it is considered that mutual assistance and co-operation would be of considerable advantage to the companies.

The Schuckert Company, of Nuremberg, appears to be recovering from some of the difficulties which have beset it for several months past. Probably the most important matter is the sale of the undertaking of the Bosnian Electricity Company to a syndicate, with the consent of the Government of Bosnia and Herzegovina. The Nuremberg Company was interested in the Bosnian concern to the extent of £200,000, but it was officially announced on October 29th that the undertaking had been disposed of, and that the loss to the company only amounted to £25,000. As to the general situation, it was stated on the same occasion that the value of the goods invoiced to the branch establishments was only £15,000 less than in the corresponding period of last year, whilst the deliveries of manufactures from the head works were not considerably behind those of the previous year. The work in connection with large central stations and tramways has, however, largely diminished. No statement was made at the board meeting for publication as to the proposed working agreement with the Allgemeine Elektricitäts Gesellschaft, of Berlin, although in some quarters the arrangement is thought to cover more than a proposal to regulate prices and business transactions.

The report of the Helios Electricity Company, of Cologne, will come as an unpleasant surprise to the shareholders, although not to those who were inclined to think a few years ago that many of the German companies were proceeding with too much haste in extending their sphere of activity in different directions. Founded in 1884 with the modest capital of £50,000, the amount since 1894 has rapidly been advanced to £1,000,000; and although dividends were not paid in the early days, distributions up to as high as 12 per cent. have been declared since 1894, and even 7 per cent. was paid for 1899—1900 on £800,000. That the financial position was known to be far from satisfactory is shown by the fact that in July last Herr Pfankuch, the new general director, submitted a scheme for governing the future policy of the company. It was then decided to make exhaustive alterations in the internal organisation, to wind up old concessions as rapidly as possible and to embark on new ones only to a moderate extent, and to mainly depend upon the manufacturing and selling branches for solid accounts. This programme has been followed since July, but notwithstanding this, a remarkable state of affairs was disclosed at a meeting of the directors on October 9th, when a report was submitted showing that heavy losses had been incurred during the year. The company's report, which has now been issued, exhibits an even more unsatisfactory state of affairs, inasmuch as the actual deficit for the year amounts to no less than £418,320. Of this total, £77,802 represents the loss on working, as compared with a profit of £163,575 in the previous year, whilst it has been found necessary to write down stocks to the extent of £114,158, and investments by £112,802. By drawing upon the reserve fund, amounting to £151,461, and on two other accounts the deficit has been reduced to £245,320. The directors attribute the enormous loss to the diminution in the value of the securities held by the company, the decline in the value of raw materials and the heavy amounts which have had to be written off for depreciation.

The Busch Electric Car Works Company, of Hamburg, which is financially interested in the English firm of Messrs. G. F. Milnes and Co. to the extent of £32,610, has found it necessary to reorganise its affairs in consequence of the loss of credit through the collapse of the Dresden Credit Anstalt and other failures, and the loss of £15,000 in connection with the Kummer failure. In 1897—1898 and 1898—1899 dividends were paid at the rate of 9 per cent., but in 1899—1900 it was only possible to distribute 4 per cent. The position of affairs, however, became so critical that the directors convened an extraordinary meeting of the shareholders, who eventually agreed to a scheme of reconstruction either for writing down the share capital by four-fifths or for paying up 33⅓ per cent. on the amount of the shares held; in the latter case the payments must be £35,000 as a minimum. It is anticipated that this scheme will improve the position of the undertaking. The company, which is carrying out repeat orders for Messrs. Milnes & Co., has found the construction of electric cars to be insufficient to keep its works in operation, and there have been added branches for the building of railway wagons and under-frames for electric tramcars.

The directors of the Mix & Genest Telephone and Telegraph Company, who held a board meeting in October, had under consideration a report of the course of business during the first eight months of the current year. It was pointed out in the report that the company's trade had continued in a favourable condition, and that transactions have been equally as considerable as in the corresponding period of the previous year. The depression which prevails in nearly all industries has not affected the company, which has sufficient financial means at its disposal. It is expected, from the results already obtained, that the year's trading will terminate satisfactorily.

The D. E. W. Garbe, Lahmeyer & Co., of Aix-la-Chapelle, has a nominal capital of £150,000, of which only £97,500 appears to have been paid up. The sum outstanding is in arrears, and is being called up by not later than March. It is not quite clear whether the non-payment of capital is due to the present financial position of the company, but, according to the report for 1900—1, presented at the general meeting held at Aix-la-Chapelle in October, the profits for the year only amounted to £25,461, as compared with £27,754 in the preceding year. The net profits allow of the distribution of a dividend at the rate of 4 per cent., as against 8 per cent. in the previous period.

The Rheydt Cable Company, of Rheydt, has a capital of £50,000 which is now being increased by a fresh issue of shares to the extent of £25,000 at a premium of 10 per cent. In 1898—1899, which was the company's first working year, a gross profit of £1,923 was realised, whereas for the past financial year the total profit amounted to £10,367. After making provision for depreciation and reserve fund, the balance has been disposed of by the payment of a dividend at the rate of 8 per cent. as against *nil* in the preceding year. The report of the directors states that the company was fully employed during the year, and that extensions had to be made in some departments. The orders on hand at the beginning of last month were sufficient to provide work until the spring of next year.

The Accumulator Works Company, of Berlin and Hagen, continues to maintain the position of prosperity which has characterised its operations for several years past. Since 1895, when the company's capital amounted to £225,000, dividends at the rate of 10 per cent. per annum have been successively paid, those for the past three years being on the increased capital of £312,000. The gross profits for the past year amount to £145,178, as compared with £144,151 in 1899—1900, and the net profits to £51,810, as against £47,458. The net results have been arrived at after writing off considerably more for depreciation, and having paid the 10 per cent. dividend for the year and met the bonus and pension payments, the amount transferred to the reserve fund brings the latter up to one-fifth of the share capital. The company has works in Hagen, Hirschwangen and Buda-Pesth, and the aggregate of the turnover of the three for the year reached £455,000 as compared with £485,000 in the previous year. It had been found that losses were incurred by keeping large stocks of raw materials, but this difficulty has now been overcome by restricting purchases, especially of lead. The practice of maintaining accumulators for customers on the payment of annual premiums is being continued, although the company refrains from specifically stating the amount of the income and expenditure under this head, and the total sum at which the batteries are insured. All that is shown is that the excess of premiums over the outlay attained £12,890, as compared with £12,700 in 1899—1900, and the former has been transferred to the premium reserve fund, which now amounts to £65,794. In addition to its own three works the company is interested in the Russian Tudor Accumulator Works Company, of St. Petersburg, the Oerlikon Accumulator Works, the Spanish Tudor Company, Madrid, and in other undertakings; but beyond asserting that these are suffering from the financial depression, the report contains no information whatever concerning them. The industrial situation renders it difficult to form any opinion as to the future, but, according to a statement made to the shareholders by the general director at the end of October, there has, so far, been no diminution in the receipt of orders, either as regards quantity or value.

The report of the German Cable Works Company, of Berlin-Rummelburg, for 1900—1901 makes a statement which is not astounding in view of the increase in undertakings of this kind during the past few years. It complains of the severe competition in the branches devoted to the manufacture of wire and cables, but without specifying any particular classes it was officially stated at the recent general meeting that the manufacture of unremunerative goods had now been abandoned, and that the chief resources are being devoted to the production of those manufactures which yield greater profits. The company was unfortunately interested in the Kummer liquidation to the extent of £4,000 for delivery of goods, and the special reserve fund has had to be drawn upon in order to cover the loss. The gross income for the year amounted to £33,258, and after allowing for depreciation and other matters, the shareholders receive a dividend of 4 per cent. as against 8 per cent. in the previous year. It is understood that business is more active and the prospects for the future are considered to be brighter.

THE RATING OF ELECTRIC LIGHT AND POWER STATIONS.

(*Continued from Vol.* 48, *page* 733.)

The importance of some equitable system of apportionment between neighbouring parishes has long been recognised in connection with gasworks and waterworks, and the rule applied to such undertakings probably applies with equal force to undertakings for the supply of electricity

A reference to one or two cases will show the origin of the rule which is now generally acted upon. In R. *v.* the Churchwardens and Overseers of Mile End Old Town [(1847) 10 Q.B., 208], the works of a water company extended into several parishes, and consisted of two portions, one of which, being the service pipes which delivered the water to the consumer, was directly productive of profit, and the other, consisting of reservoirs, buildings, &c., indirectly conduced to such production. In some parishes the company had no works, but only service pipes. The rateable value for the purposes of poor rate of the whole of the works was £30,800. The rateable value of the reservoirs, buildings, &c., valued as land and

buildings deriving additional value from their capacity of being applied to the objects of a water company, was £6,500. It was decided that the rateable value ought to be apportioned among the several parishes in the following manner:—The rateable value of the reservoirs, buildings, &c., valued as above to be first deducted from the total rateable value, and distributed among the parishes in which this portion of the works was situated, according to the extent of such works in each parish, and the residue of the rateable value to be apportioned among the parishes containing the service pipes, in the ratio of the net profits produced in each of those parishes. The following extract from the judgment of Denman, C. J., embodies a clear statement of the law:—"It is clear that the net profits in each parish would be the best criterion of such rent; and they would, therefore, give the proper ratio. It is also clear that the ratio of the gross receipts or earnings in the several districts to each other will be the same as the ratio of the net profits in those districts to each other, in all cases where the total of the expense is taken to be common to the whole apparatus, and is deducted from the total of receipts in the process of ascertaining a rateable value. For in such case the net profits in each district would be ascertained by distributing the expenses among the several districts; and they would be distributed in the ratio of the gross receipts in each; and, if a proportional deduction should be made from the gross receipts in each, the ratios of the remainders to each would be the same as the ratios of the gross receipts."

Referring to the case of R. *v.* The Cambridge Gas Light Company (8 A. and E. 73), Denman, C. J., said:—"The Court there decided that the parishes in which the profits are received are not entitled to all the amount produced by the rate, but that the parishes in which parts of the apparatus indirectly conducing to produce profit are situate are entitled to a proportion. The Court in that case also declared that the principle upon which the sum of rateable value from the rates of all the parishes should be apportioned, is the same as that which had been applied to canals. By the method adopted in this case the rateability of the portion of the apparatus indirectly conducing to produce profit is provided for, and the residue of the sum of rateable value is apportioned to those parts of the apparatus directly producing profit in analogy to the mileage proportion for canals and railways."

The principle laid down in the Mile End case was adopted and confirmed 12 years later in R. *v.* The West Middlesex Waterworks (1859), 1 E. & E., 716. There the defendant company were empowered by their Acts to construct works and lay mains and pipes through and under certain highways, roads, &c., and to supply certain parishes with water. The company erected in the parish of Hampton, not being one of those parishes, engine houses and other works, and laid down a main thence, part of which ran through Hampton, conveying the whole of the water to reservoirs in another parish, from which reservoirs the water was distributed, through other mains and pipes, to the customers of the company in the several parishes named in their Acts. The company derived no direct profit in Hampton, and had no freehold or leasehold interest in the soil of the highway. The rateable value of the company's plant, engine house, cottages, wharfs, mains, and land, with premises in the parish of Hampton, was estimated to be £2,300. The company contended on appeal against the rate that they were not rateable at all in respect of their main in Hampton, and that their works in that parish should be rated as ordinary buildings, without reference to the profit earned by the company, and that even if the Court should be of opinion that the company were liable to be rated in respect of their main, such liability only extended to the land actually occupied by such main, and did not extend to profits derivable from other parishes supplied.

It was decided (*a*) that the company, being in possession of the mains buried in the soil, and therefore *de facto*, in beneficial occupation of the part of the soil occupied by the mains, were rateable to the poor in respect of them; (*b*) that as regarded the principle of assessment, the company were to be rated in Hampton in respect of the plant, engine houses, buildings, wharves, mains, lands and premises, as for more lands and buildings with fixtures and machinery attached, and deriving some additional value from their capacity of being applied to such purposes as that of a water company; such additional value being derived from an increase of demand beyond supply, according to the principle regulating exchangeable value, and not by reference to receipts earned in another parish beyond assuming that they were sufficient to pay for all outgoings, including profits on capital. The reasons for this judgment were clearly expressed by Wightman, J., in the following language:—"It is clear that each parish must rate the part which lies within it: such part becomes a separate rateable subject in that parish, and must be rated according to the Parochial Assessment Act, upon an estimate of the rent which that part would yield after proper deductions. In practice a tenant of the parochial portion of a canal, railway, gasworks, waterworks or the like, has rarely, if ever, been known. But an hypothetical tenant must be assumed. . . . . Although each parish rates separately upon its own estimate of the value of the part lying within it, and the law gives no power of making all the parishes co-operate in rating the several parts lying in each, nevertheless this Court is bound to protect the occupier of such an apparatus from being rated beyond the rateable value of the whole taken together; and it is in reference to this protection that the Court must take into its consideration all the separate rates at once, as so many claims upon one given fund, and must apportion that fund, bearing in mind that every addition to the rateable value assigned to one parish must be a subtraction from the rateable value which might be given to some other parish. Supposing, then, the apparatus to be apportioned to several tenants according to the parts in several parishes, the tenants of the parts directly earning net profits in a parish would be rated by that parish for all the profits earned therein, this being the parochial principle of apportionment which has been unanimously upheld hitherto in respect of all canals, railways, water companies, gas companies, and bridges. But the tenants of the parts directly earning no profit would not be liable to be rated in respect of any rent, in the ordinary sense, which is profit remaining after all deductions have been taken from the receipts.

"But as these parts of the apparatus directly earning nothing, but indirectly conducing to such earnings elsewhere, are assumed to continue in operation, the company, to whose interest such continued operation is essential, must be assumed to pay adequate remuneration to a contractor for land and fixed capital vested therein, together with the labour and skill requisite for the effective continuance of such operation; and this contractor with the company would stand in the relation of occupying tenant to the parish, and the part within the parish would be the rateable subject, and the local rateable value would be such sum as would pay the rent of the land and the profit on fixed capital therein."

The decisions in the Mile End case and in R. *v.* West Middlesex Waterworks have been considered and approved of in Chelsea Waterworks *v.* Putney [(1860) 29 L.J.M.C., 236] and in R. *v.* Sheffield Gas Company [(1863) 32 L.J.M.C., 169].

The principle to be deduced from the foregoing cases has thus been summarised by Mr. Ryde in his excellent work on the "Law of Rating" at p. 255:—"The rateable value of the whole system being ascertained, the rateable value of the indirectly productive part is subtracted therefrom, and the residue is divided among the several parishes into which the directly productive part extends in proportion to the gross or net receipts earned in these premises."

The following example will serve to show how the share of each parish may be arrived at by a simple proportion sum.

Example IV.

Apportionment Amongst Different Parishes.

Assume that x is the rateable value of an entire undertaking which is situate as to the works and land and part of the mains in one township, and as to the rest of the mains in two other townships.

The form will then be as follows:—

Total receipts for current.		Receipts for current in parish.		Rateable value of mains.		Rateable value in parish.
£10,000	:	£5,000	::	£1,000	:	Mains = 500 A
£10,000	:	£4,000	::	£1,000	:	Mains = 400 B
£10,000	:	£1,000	::	£1,000	:	Mains = 100 C
		£10,000				£1,000

Suppose the generating station were situated in the parish of C, and that it was assessed according to Example III. (*ubi supra*) at a rateable value of £1,200, the total rateable value of the undertaking would then be £2,200.

Apportionment—Between Supply Station and Mains.—It has already been pointed out that for the purpose of apportioning the rate between different parishes, it is necessary to value the station itself, *quâ* station, as apart from the mains or profit producing part of the undertaking. Such an apportionment is necessary for the purpose of adjusting the proportion which must be paid in respect of the property situate in the parish where the station is situated. It may also have an important effect in a case where the rates levied in the different parishes are unequal.

The following example will serve to show how this apportionment is made:—

Example V.

Apportionment Between the Supply Stations and Mains.

Rateable value of the entire undertaking ... ... £

Rateable value of supply station, including buildings and plant [referred to as the unproductive portion] ... ... £

Land ... ... £

£ at* – % = £

Rateable value of the mains or directly productive portion ... £

* In estimating the value of the unproductive portion, regard must be had to the value of money at the time, and to the return which property of the kind would be likely to yield.

(To be continued.)

THE BERLINER AUTOMATIC INTER-COMMUNICATION TELEPHONE.

This apparatus, which is an arrangement brought out by the Berliner Telephone Manufacturing Company, for telephonic intercommunication between the various rooms in a house, hotel, office, warehouse, or other establishment, is an extremely well-devised and efficient combination. The apparatus is made in several forms, two of which are shown, fig. 1 being a "table," and fig. 2 a "wall" arrangement. In order to call up a particular room, the micro-

telephone is taken off the hooks, and the switch lever corresponding to the room required is then pulled to its limiting position, at which position it becomes locked; the bell button is pressed, and on the acknowledgment being received, the communication is carried on. If any other room is required to be called, then the corresponding lever

Fig. 1.

is pulled, and the movement of this lever, by a locking bar device, causes the lever previously pulled to be released, so that it springs back to its normal position. When the micro-telephone is replaced on the hooks, then the lever last pulled is, by this replacement, similarly released, so that at the finish all the levers are in their normal position.

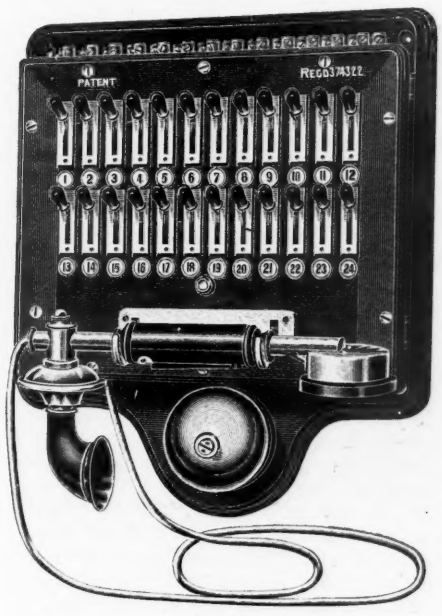


Fig. 2.

The whole arrangement is, it will be seen, extremely simple, and, moreover, the mechanical movements which effect the object are well designed and made, so that liability to get out of order is reduced to a minimum; in fact, it might almost be said that there is nothing to get out of order. It may be added that the general finish of the apparatus is excellent.

HIGH SPEED TRACK.

The question of high speed travelling is very much to the front at present, possibly as a sequel to the publicity given to Behr's five-rail **A** frame "mono-rail" system, and so much has been made of the supposed necessity of holding a train to its line of travel, that the laws of motion have evidently escaped the minds of some engineers altogether. One of the laws of motion is to the effect that when a body is in motion it will keep in motion in a straight line at the same velocity, and only some externally applied force will alter either its velocity or direction.

Our esteemed contemporary, the *Electrician*, appears to have doubts, which we cannot think are well founded, as to the possibility of constructing a permanent way fit and strong enough to carry a train at 120 miles per hour, the speed suggested by the German Association for the study of electrical high-speed railways. Our contemporary puts aside the question of centrifugal force, and asks the effect of wheel loads of 7 tons running at such speeds. Confining ourselves also to straight lines, it is clear that the higher the speed, the less will be the tendency to leave the track, or rather, we should say, the stronger will be the absolute adherence of the car to the straight line. The heavy load must move straight, because no external force is acting to throw it off the straight.

Now, as regards wheel loads of 7 tons per wheel, we would simply say that steam locomotives exceed 9 or even 10 tons per wheel, and have done so for years.

The fact of high speed has no bearing on the rail stresses. A suddenly-applied load produces an effect double that of the same load slowly applied or static. Had a rail absolutely no deflection, there would be no increase of stress possible with live loads, as distinguished from static loads. Live loads do not owe their effects to the fact that they are live loads, but to the fact that beams deflect a certain amount for every increment of load, and when a beam thus retreats, as it were, before attack, it brings to bear upon the attacking load the accelerating effect of gravity, and it is the final effort of the beam to repel this dynamic effect that ultimately doubles the stresses. Assuming that a rail is supported at points 2 ft. apart, the passage of a load across the half span to the position of greatest moment will occur in $\frac{1}{8}\frac{1}{5}$ second if the velocity is 60 miles per hour. The distance fallen by a body is $16\ t^2$, where t is the time in seconds. Hence, in $\frac{1}{8}\frac{1}{5}$ second, the travelling load will fall 0·002 ft., or, say, $\frac{1}{4}\frac{1}{0}$ in. In the whole span of 2 ft. the load would only drop $\frac{1}{1}\frac{1}{0}$ in., and a springless vehicle would not notice gaps 2 ft. long cut out of the rail if the further end rail were gently depressed this amount of $\frac{1}{1}\frac{1}{0}$ in. With springs, however, the effect is worse. A spring over a locomotive axle box is compressed with a load of, say, 9 tons. The wheel and axle below the spring weigh, possibly, $1\frac{1}{2}$ tons, and the 9 tons of accelerating effect of the spring would cause them to drop six times more than an unsprung vehicle would drop by gravity alone. As, however, we are dealing with the whole weight on a wheel, the time drop of $\frac{1}{4}\frac{1}{0}$ in. is what concerns the matter in hand. What is the deflection of a piece of rail 2 ft. long? For argument, we will assume that it deflects $\frac{1}{2}\frac{1}{0}$ in., which is less than the gravity drop of the load. Obviously, therefore, a load at 60 miles an hour advancing over a rail supported at intervals of 2 ft. must produce a stress of double its static effect in all cases where the rail deflection is less than the gravity drop of the advancing load. Since no load can produce more than double its static effect, it follows that at any higher speed than 60 miles the breaking effect of a loaded wheel cannot be more serious than at present ordinary velocities. Indeed, it follows as a natural corollary that the effect must be less. The gravity effect at 120 miles per hour would be a drop of $1\frac{1}{6}\frac{1}{0}$ in., or only one-third the assumed rail deflection.

The impact would no longer produce double static stresses. Hence there need never be any fear of high speeds, so far as regards their downward effect on the track, and track that is good for 60 miles velocity, will be equally good at 120, or for that matter, probably, 600. As an example, the tracks of the North-Western or Great Western are practically perfect, and any velocity that an electric car could develop would be safe and easy on their straight portions. The electric car, unlike the steam locomotive, can have perfectly balanced rotatory parts, and this further simplifies the matter. Good permanent way is simply a question of well drained stone packing under sound sleepers carrying stiff rails, levelled and adjusted to the eye of a rough platelayer, who is probably very little educated. Yet we all trust our lives to the skill of these men, who never saw a college class room. For ourselves, we believe the existing track of our main line railways is fully equal to the highest speed that an electrical car will attain. As regards curves, railway engineers could possibly give a superelevation for any speed, and would demand flattening of many curves. The difficulty with high speed on a fixed pair of rails is, of course, that the superelevation of the outer rail is so great, that low speeds cannot safely be run round such curves. The object of superelevation of the outer rail is to provide that the resultant of gravity and centrifugal force shall pass through the web of the rail, or normal to a line across the two rail surfaces. In a superelevated bicycle track the same effect is produced, the rider placing his machine normal to the track surface, so as to run on the full diameter of his tire. As speed round a curve cannot be guaranteed a maximum, it is obvious that on high-speed railways the curvatures must be everywhere made so flat, that the necessary superelevation of the outer rail, to ensure safety at high speeds, shall be so small as not to introduce danger at low speeds. Mr. Behr thought to get over this difficulty by confining his train on an **A** frame; but the centrifugal effect on the passengers could not be provided against by this system, the safety of which is doubtful, even for the train, and we believe his later proposals have recognised the need of very much flatter curvatures than originally contemplated. Now that the curvature is seen to be so much a matter of the unit stress in the passenger, and not a matter of safety of permanent way, why not attempt maximum speeds on ordinary first-class track? After all, the chief problem will be that of stopping, and we cannot think that the braking effect of clip brakes on an **A** frame structure can result in anything but disaster, unless the greatest care is exercised, both in the car and in the structure, to meet the enormous tearing stresses that will be generated.

PHYSICAL SOCIETY.

Ordinary Meeting held October 25th, 1901.

Prof. S. P. Thompson, President, in the Chair.

A paper "On the Variation with Temperature of the Thermo-Electromotive Force, and of the Electric Resistance of Nickel, Iron and Copper, between the Temperatures of − 200° and + 1,050°," was read by Mr. E. P. Harrison.

In this paper the changes with temperature of the thermo-electromotive force and the resistance of nickel and iron are traced over a wide range, and the singularities present in the curves representing these changes are investigated. In all experiments the same specimens of metal were used. Previous work on this subject has been performed by Tait, Fleming and Dewar, Holborn and Day, and Stansfield. In the author's experiments on E.M.F., an ordinary potentiometer method was used, the potential difference due to the thermo-couple being balanced against a portion of that due to two accumulators. Before each reading a standard cadmium cell was balanced on a definite resistance in the accumulator circuit. Readings of E.M.F. of copper-nickel couples were accurate to 1·8 microvolts, while those of copper-iron couples were accurate to less than 1 microvolt at moderate temperatures. The heating arrangement was designed to give a uniform temperature, which was measured by a platinum thermometer and recorded automatically by Callendar's recorder. The cold junctions were placed in a large test tube full of water, the test tube being placed in a larger vessel also containing water. The temperature of the cold junctions varied with that of the room, and all observations were reduced to cold junctions 0° C. Finally, in each case, observations were taken by placing the junctions in liquid air with the platinum thermometer beside them. To prevent oxidation of the metals forming the junctions at temperatures above 500°, it was necessary to exhaust the porcelain tubes which contained them. The curves for variation of E.M.F. with temperature of copper-nickel and copper-iron couples are, roughly, a straight line and a parabola respectively. The differences between the actual curves and a selected straight line in the former case, and a parabola in the latter case, have been plotted against temperature. These difference curves show that the maximum variations occur, in the case of copper-iron, at 70°, 230°, and 370°. The temperature of inversion (cold junction 0° C.) is 536° C., and the neutral point is 262° C. In the case of copper-nickel, maximum variations occur at 70° and 340°, and there appears to be a small hysteresis effect at the latter point. The temperature of inversion does not occur within the limits of the experiments, and there is no neutral point. The E.M.F curve for a nickel-iron couple up to 700° has been obtained from the two previous experimental curves by addition. Above this temperature direct observations have been taken. This curve is nearly linear up to 900°, at which point a decrease in E.M.F. occurs. Curves of thermo-electric power have been derived from the E.M.F. curves by drawing tangents, and these show that a considerable range of the copper-iron curve can be represented by straight lines, but that the remainder is approximately parabolic. The copper-nickel power curve can be represented by bits of straight lines. The Peltier coefficient variation curve for iron-copper is at first parabolic, and can then be made up of straight lines; for copper-nickel it can be made up of bits of parabolas. Considerable difficulty was experienced at high temperatures in getting concordant results, owing to chemical changes and other effects. The experiments were, therefore, carried out under different conditions, and the results are discussed in the paper.

In the resistance experiments a potentiometer method was employed, a manganin resistance coil immersed in an oil bath being used as a standard. The resistance of nickel increases with temperature almost parabolically up to 370°, when a change of slope occurs, and the resistance increases much less rapidly and almost linearly up to 1,050°. In the case of iron the resistance curve does not change its parabolic form till nearly 800°, when it becomes linear, and remains so up to 1,050°. The author concludes from his paper that the thermo-electric change in nickel-copper coincides approximately with the resistance change, but that no thermo-electric peculiarity exists for iron-copper at the temperature of the iron resistance change.

Mr. A. Campbell said that with purer iron the change in thermo-electric properties might correspond with the change in resistance. Dr. Knott had performed experiments on nickel in 1886, and got results similar to those of the author. His results with thick wires were different from those with thin, probably because he did not exclude air and prevent oxidation. Mr. Campbell said that he had himself made experiments upon two samples of nickel differing in resistivity, and although their temperature coefficients were also different, the change in slope of the curve connecting resistance and temperature occurred at practically the same temperature in both specimens. Their thermo-electric powers were identical up to 300°, but above they differed slightly.

Dr. D. K. Morris pointed out that the thermo-electric force, the resistance and the magnetic properties should be observed at the same time. In taking a thermo-electromotive force there must be a temperature gradient, and in the interesting parts of the curves differences of magnetic properties may arise and produce discrepancies. He drew attention to the caution which must be exercised in differentiating by drawing tangents except when the curves are smooth. Dr. Morris said the connection between resistance and magnetic qualities was interesting. The temperature coefficient of resistance of a magnetic body rises with temperature so long as the body is magnetic, but reverses when the body becomes non-magnetic. He asked for information on the subject.

Prof. H. L. Callendar said he had followed the research with interest, and referred to the experimental difficulties, especially at high temperatures. He should like to have said something in reply to Dr. Morris, but he was afraid the subject was a large one and might well be discussed at some future meeting. There were several points to clear up, and the fact that the curves described cannot be represented by straight lines or parabolas showed that the subject was beyond the range of a simple theory.

The Chairman suggested that it might be well to re-examine more carefully some of the curves which are accepted as straight lines and on which there is no complication due to magnetic properties. He hoped the author and others would continue working at this subject.

Mr. E. P. Harrison, in reply to Dr. Morris, said he thought the number and accuracy of his observations justified him in drawing tangents to form his power and Peltier effect curves.

A paper on "Asymmetry of the Zeeman Effect," by Mr. G. W. Walker, was read by Mr. W. Watson (secretary).

Prof. Voigt predicted an asymmetry of the normal triplet, which has been verified by Zeeman. The author has considered the subject mathematically, and finds that asymmetry may arise as a second order term due to the magnetic field. The asymmetry would be more distinct the greater the field, which is opposed to the theory of Voigt. By giving numerical values to the symbols it is shown that the effect is extremely small. The author points out that his theory can provide an explanation of why a line may not be resolvable.

LORD KELVIN'S ELECTRICAL MEASURING INSTRUMENTS.

Lord Kelvin has been so long associated with the University that looks down from Gilmorehill upon the Glasgow Exhibition, that it was but fitting that the Institution of Electrical Engineers at the International Engineering Congress should have been given a general review of Lord Kelvin's work in the domain of precise electrical measurement. We suppose that no one will dispute the assertion that the Cambridge Street workshop of Kelvin & White is the birthplace of the concrete standards to which electricians generally refer; for was it not from thence that the Board of Trade obtained the actual instruments which to-day embody the legal standard ampere and volt? The various instruments which owe their creation to Kelvin's inventive genius have been described times without number, and there is hardly a scientific society in existence whose proceedings do not contain at least one memoir, paper or article, popularising the knowledge of the instrumental aids to precision which bear his name. The British Association reports, the *Proceedings* and the *Transactions* of the Royal Society, the *Philosophical Magazine*, and the technical press for the past 20 or 25 years are fertile ground for the student who has time to wade through their files, but a new generation is arising which has not the knowledge of the seventies and eighties, and to them the paper by Dr. Magnus Maclean is valuable as a saving of labour, epitomising what everyone ought to know, but what a good many of those we meet from time to time do not. For example, few are aware that the principle of the Wheatstone bridge was independently discovered by Lord Kelvin, who used the method in some classical researches "On the Electro-dynamic Qualities of metals," and only learnt an hour before the meeting at which his paper was read, that to Wheatstone belonged the honour of prior publication. (Mathematical and Physical Papers, Thomson, Vol. ii., p. 301.) The better known papers are the "Report on Electrometers and Electrostatic Measuring Instruments" (B.A. reports, 1867; Article XX. of "Collected Papers on Electrostatics and Magnetism"), and "On New Standard and Inspectional Electrical Measuring Instruments" (*Jour. Inst. Elect. Engrs.*, Vol. xvii., p. 540, 1888), but the intermediate links are to be found in the *Transactions* of the Physical Society of Glasgow University, and the Philosophical Society of Glasgow. One of these: "On a double chain of electrical measuring instruments to measure currents from a millionth of a milli-ampere to 1,000 amperes, and to measure potentials up to 40,000 volts," gives, by its mere title, an idea of what ground was even then covered (April, 1887). As Mr. Meikle said when,

in November, 1892, he described further advances in the *chains* then spoken of, "they form the recognised standards in all parts of the world." At the end of the 1887 paper the then Sir Wm. Thomson said, in thanking his audience for listening to a description of "half-done work," he had told them of what "he hoped to do, but had not as yet done, in the way of producing practically useful instruments." This expectation has been more than fulfilled, and to-day the electrician would be badly off were some unkind fate to cut him off from the resources of the erstwhile "James White, Glasgow."

Dr. Magnus Maclean's paper covers much the same period as our article on the progress of electrical instrument making in the special number of the ELECTRICAL REVIEW on November 12th, 1897. In the last 20 years Lord Kelvin has taken out some 27 patents relating to improvements in electrical instruments, and the voluminous character of the specifications is evidenced by their containing 185 pages of descriptive matter, and 126 sheets having 297 diagrams or illustrations. In appendices to Dr. Maclean's paper will be found a bibliography or summary of these patents, and of 11 others relating to telegraphy. Of the paper itself we published an abstract in our issue of September 6th. Prof. Andrew Gray's large and small treatises on measurement, read together with the above list, form an excellent introduction to the paper, from which we cull a classification of the instruments in the form in which they are now constructed.

Classification by description.

A.—Kelvin electrometers.
1. Symmetrical:—
   a. Quadrant.
   b. Multi-cellular.
   c. Vertical scale.
2. Attracted disc:—
   a. Absolute.
   b. Long range.
   c. Portable.
   d. Electrostatic balances.

The range covered by the electrometers is from ·01 volt to 100,000 volts. An auxiliary instrument is the air Leyden or standard air condenser.

B.—Kelvin electro-magnetic instruments.
1. Moving magnet:—
   a. The reflecting galvanometer.
   b. The "graded" galvanometer.
2. Moving coil, in the following forms:—
   a. Edgewise.
   b. Round.
   c. Illuminated dial thistle.
   d. Portable in aluminium case.
   e. Portable paralleling.
   f. Reflecting mirror.
3. Ampere gauges (of the solenoidal, sucked-in iron core type):—

C.—Kelvin electro-dynamic instruments. Balances:—
   a. For currents from ·01 to 2,500 amperes.
   b. For powers up to 50 KW. and 10,000 amperes.
   c. Indicating instruments (of the engine room wattmeter pattern).

D.—Kelvin recording and integrating instruments:—
   a. For currents.
   b. For pressures.
   c. For powers.
   d. For combinations (as in the "Feeder logs").

In the paper, the classification by uses is also adopted in this form:—

1. Standard instruments:—
   a. Ampere balances.
   b. Watt balances.
   c. Multi-cellular electrostatic voltmeters.
   d. Vertical E.S. voltmeters.
   e. Quadrant electrometers.
   f. Absolute electrometers.
2. Portable instruments:—
   a. Horizontal multi-cellular voltmeters.
   b. Portable suspended-coil ammeters and voltmeters.
   c. Testing set for measuring insulation resistance.
   d. Cell tester.
   e. Rail-joint tester.
   f. Paralleling voltmeters.
   g. Graded galvanometers for currents and pressures.
   h. Portable electrometers.
3. Central station instruments:—
   a. All the electrostatic voltmeters.
   b. The suspended coil voltmeters and ammeters.
   c. The ampere gauge recording ammeters and voltmeters, including the "feeder log."
   d. Earth-current recorder.
   e. Astatic recording voltmeter for alternating currents.
   f. Recording wattmeters.
   g. All the types of ampere gauges.
   h. Engine room wattmeters.
   i. Three-phase wattmeters.
   j. Rail-joint tester.

In connection with the siphon recorder or moving coil pattern of galvanometer, Dr. Maclean says:—The first suspended coil instrument was the invention of the Rev. H. Highton, and was used as a receiving instrument about 1856, being "greatly improved by Lord Kelvin, who introduced a fixed soft-iron core in the siphon recorder of 1867, which has made the present form of instruments practically valuable." Mention may be made of a contradictory opinion in the paper on "Galvanometers," by Ayrton, Sumpner, and Mather (Physical Society, London, January, 1890); it was stated that the coils of such galvanometers should be long and narrow, and that there should be no internal core; a view also held by Prof. Boys, judging from his radio-micrometer. The argument was elaborated by Mather in a paper "On the Shape of Movable Coils Used in Electrical Measuring Instruments." (Physical Society, London, March, 1890.)

As regards the moving-magnet pattern of galvanometer, we cannot do better than close this brief review by quoting from the excellent little work of Prof. E. L. Nichols ("The Galvanometer," 1894, p. 69): "The demands of submarine telegraphy were completely and beautifully met in the mirror galvanometers by Thomson. In these well-known instruments, the mass of the moving parts was, for the first time, reduced to a small quantity. The needle was reduced by Kelvin to a system of short, thin strips of steel, the length of each of which was but a few millimetres, while the aggregate mass was but a few milligrammes. In his hands, also, the mirror was reduced in weight in like proportion by the substitution of microscopic cover glass for polished metal, and in his instruments, also, we find for the first time the coil brought into really close proximity to the needles. The result of these changes was an instrument, the sensitiveness of which far exceeded that of any instruments which had previously existed, while the quickness of action necessary in cable signalling was secured by the reduction of the mass of the moving parts." Thus (as we remarked on page 336 of the ELECTRICAL REVIEW in November, 1897), "The Thomson reflecting galvanometer, having a magnetic system movable near fixed coils, has practically remained in the form in which it existed in 1872. Attempts have been made in many directions to improve the instrument, but without marked success, except by Vernon Boys's discovery of the singular properties of the quartz fibre."

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be as brief and concise as possible. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"FOREMAN" writes:—"In the case of a workman being summarily dismissed for misconduct, can he be forcibly ejected from a workshop if he refuses to go by himself, or are the ejectors liable to an action for assault? Also, if it is decided to dismiss a workman in the middle of a piecework job, is it necessary to pay him the full amount of the piecework contract, even if the work be only just commenced?"

*** If a workman is guilty of such misconduct as would justify his dismissal without notice, we think that his employer would be entitled to eject him from his premises, using no more force than absolutely necessary. The cause of the dismissal would prove quite a sufficient answer to an action for assault, if the workman were so ill-advised as to bring one. It may also be pointed out that if a workman is violent or disorderly on his employer's premises, the master will be justified in giving him into custody, to be dealt with according to law. (Shaw *v.* Chairitie, 2 C. & K., 21.)

With reference to the second question, the employer would be under no liability to pay the full amount for the piecework, as the workman, by his own conduct, will have precluded himself from performing his part of the bargain. If any substantial portion of the work were done, it would be advisable to pay a proportionate part, in view of the fact that a workman, when summarily dismissed, is generally entitled to receive payment of wages to date.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1901.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

21,767. "Improvements in electric locomotives." B. Hopkinson. October 28th.

21,571. "Improvements in brush-holders for electric generators, motors, and the like." J. H. Holmes. October 28th.

21,600. "Improvements in electric time reminder clocks." B. Dubinsky. October 28th. (Date applied for under Patents, &c., Act, 1883, Section 103, April 1st, 1901, being date of application in United States.)

21,601. "Generating of electric currents by conductors cutting a magnetic field by a new device." F. G. Humaran. October 28th.

21,602. "Improvements in polarised electro-magnets." L. Cerebotani and C. Moradelli. October 28th. (Complete.)

21,608. "Improvements in and relating to arc lamps." W. Rowbotham and K. A. Rowbotham. October 28th.

21,646. "Improvements relating to carbons for arc lights." H. Viertel and C. Pueschel (of the firm of Gebrueder Siemens & Co.) October 28th.

21,665. "Improvements in the construction and production of the terminals of electric glow lamp sockets and in their fitting to, and insulation from, the casing of the said sockets." C. Y. Hopkins. October 29th.

21,686. "New or improved controlling apparatus for the trolley poles of electrically-propelled vehicles." A. Coke. October 29th.

21,703. "Improvements in electric motor controllers." J. G. Childs. October 29th.

21,715. "Improvements in electricity meters and other electrical instruments of precision." R. S. White. October 29th. (Complete.)

21,721. "Improvements in frogs or switches for overhead electric traction." P. Dawson and F. W. Fawdrey. October 29th.

21,744. "Improvements in apparatus for the wireless transmission of electric oscillations." A. F. Collins. October 29th. (Complete.)

21,750. "Improvements in method of and means for tandem connecting asynchronous alternating electric current motors or generators." E. Danielsen. October 29th. (Complete.)

21,767. "Improvements in windings for electro-magnetic spools or coils." J. A. Heany. October 29th. (Complete.)

21,769. "Improvements in incandescent electric lamps." A. D. Raine. (H. A. Macdonald, France.) October 29th.

21,807. "Improvements in electric cable conductors." W. E. Hitch. October 30th.

21,809. "The patent electric light rotary, adjustable, telescopic slide." T. Ferguson and B. Barber. October 29th.

21,849. "Improvements in microphones." W. Deckert. October 30th. (Complete.)

21,878. "Improvements in or connected with electric time switches." E. Morgan. October 30th.

21,892. "Improvements in incandescent electric lampholders." The Birmingham Photographic Company, Limited, and F. Alston. October 31st.

21,915. "Improvements in the electro-deposition of metallic copper." A. Philip. October 31st.

21,919. "Improvements relating to electric ignition appliances for internal combustion motors." H. Lucas and C. Y. Hopkins. October 31st.

21,935. "Improvements in incandescent electric lamps." J. McCullough. (Date applied for under Patents, &c., Act 1883, Sec. 103, April 2nd, 1901, being date of application in United States.) October 31st. (Complete.)

21,942. "Process for the electrolytic treatment of tin, and an apparatus therefor." P. Nauhardt. October 31st. (Complete.)

21,955. "Improvements in machines for picking up and laying submarine cables." W. C. Johnson. October 31st.

21,974. "A new or improved collector for use on electrically-propelled or lighted vehicles." W. Griffiths and B. H. Bedell. October 31st.

21,981. "Improvements in and connected with galvanoscopes and means of actuating one or more relays thereby." J. T. Armstrong and A. Orling. October 31st.

21,984. "Improvements in or relating to electric coils for oscillatory discharge." A. Radiguet and G. Massiot. October 31st.

22,002. "Improvements in and in tools for use in producing sheet metal cases for electricity meters." S. J. & E. Fellows, Limited, and W. H. Corker. November 1st.

22,012. "Improvements in fittings for conduit systems of electric wiring." L. H. Lander and The Simplex Steel Conduit Company, Limited. November 1st.

22,031. "An improved system for obtaining variable speeds in direct current electric motors." The British Thomson-Houston Company, Limited. (J. A. Essberger, Germany). November 1st. (Complete.)

22,032. "Improvements in alternating electric generators." H. M. Hobart. November 1st.

22,033. "Improvements in alternating electric current motors." H. M. Hobart. November 1st.

22,034. "Improvements in potential regulators for rotary electric converters." H. M. Hobart. November 1st.

22,035. "Improvements in damping devices for rotary electric converters." H. M. Hobart. November 1st.

22,036. "Improvements in armature windings for dynamo-electric machines." H. M. Hobart. November 1st.

22,037. "Improvements in armature windings for dynamo-electric machines." H. M. Hobart. November 1st.

22,038. "Improvements in rotary electric converters." H. M. Hobart. November 1st.

22,041. "A new or improved device for use in connection with electrical ignition of explosive engines." R. Fox, C. W. Higgs, and A. Brown. November 1st.

22,044. "Improvements in or relating to safety devices for the trolley poles of electric railways and tramways." J. H. Clarke. November 1st.

22,077. "Improvements in musical instruments such as pianos, organs, musical boxes, and the like, adapted for use on electric circuits." H. J. Salter and H. Thorpe. November 1st.

22,098. "Transmitting electrical energy to tram or railway cars." J. E. Slack and H. Hutchinson. November 2nd.

22,110. "Improvements in or relating to electric motors." O. H. Pieper and A. F. Pieper. November 2nd. (Complete.)

22,146. "Improvements in and connected with the covers of inspection elbows, bends, tees, crosses, and junction boxes, for electrical wires." A. D. Robinson, S. Withers, and J. Griffin. November 2nd.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

1900.

400. "Improvements in electric arc lights or lamps." C. A. Lee. Dated January 6th, 1900. Arc lamps. An arc is formed between electrodes made of substances conducting only after preliminary heating, such as zirconia, thoria, lanthana, or mixtures of these, which may contain ceria, yttria, didymia, erbia, terbia, ytterbia, samaria, or like rare oxides. A short cone of such material is mounted on a disc of platinum, platinum mixed with alumina, magnesia, or lime, or other refractory conductor, and this is on the end of a conducting rod, the surface of the rod and disc being coated with fireclay, magnesia, or other protective material. The preliminary heating may be effected by applying a flame, or by an open coil of platinum wire enclosing the points, or by an auxiliary arc between carbons. When a heating coil is used, it is placed in parallel with the electrodes by a cut-out, until the electrodes become conductive. One electrode is carried by the core of a series solenoid, to strike the arc. When carbons are used, either the carbons or the main electrodes may be hollow, to contain the other, the carbons being withdrawn after the arch has formed; the carbons are preferably insulated from the main electrodes by refractory material. In the arrangement the main electrodes are stationary, and a movable carbon is used to strike an arc between them successively; a magnet projects the arc from the carbons against the main electrodes. Resistances in series with the carbons allow a higher pressure to be applied to the main electrodes.

420. "Improvements in electric arc lamps." H. Bremer. Dated January 8th, 1900. An arc is produced in a fixed position, either by feeding the carbons against iron or other stops, or by using them in pairs, the carbons in each pair bearing angularly together so that each supports the other. The carbons may contain metallic salts or metalloids, in the first arrangement, the coned end of a round carbon may project through a round hole in the stop. The stop may have points projecting into the hole, or the carbon have projecting edges, to admit air between the stop and the carbon. Or a hollow carbon, lined with "pure coal or coal mixed with metal 'salts,'" and with internally-projecting edges, may slide on a rod having an enlarged end to serve as the stop. One stop may be carried by a lever movable by an electro-magnet, to strike an arc. In the second arrangement, all the carbons may be in one vertical plane; preferably they pass angularly through a reflecting-plate, and are caused to feed equally either by a vertically-sliding plate resting on their upper ends, or by cord and pulley connections with a single weight. A solenoid may be provided to project the arc downward, and an electro-magnet may be provided to separate the carbons, or an additional connecting-piece, to strike an arc.

466. "Improvements in apparatus for facilitating the escape of gas from electric storage batteries or accumulators." W. J. Wells and Allan & Adamson. Dated January 8th, 1900. Relates to exits which are provided in the cover of the battery to allow of the escape of gas while preventing the escape of liquid. It consists of a tube, which is fixed in the cover of the cell, and into which is screwed a plug, through the centre of which runs a passage, the mouths of which are closed by an elastic band, which is situated between two flanges of the plug. The pressure of the gas is sufficient to move the band, but the pressure of the liquid is insufficient.

489. "Improvements in devices for locating earth contacts on electric circuits." M. J. Myers. Dated January 9th, 1900. A differential galvanometer is used to locate an earth contact on an electric circuit by connecting the two ends of the circuit separately through the differential coils to one end of a key, the other contact of which is connected through a source of current to earth; the deflection of the galvanometer when the key is pressed indicates the ratio of the resistances and distances to the fault on the two sides of the circuit. A galvanometer having two coils acting on astatically arranged needles may be used. The differential coils are on cores, and act on a pivoted armature, which carries a pointer in front of a scale in a casing. The pointer is movable by the forked arm of a rotatable knob to a position where the armature is acted on equally by the two electro-magnets.

507. "Improvements in construction and manufacture of electric bells." A. Clarke. Dated January 9th, 1900. The frame is made in one piece, and forms the core of the magnet, with flanges between which the copper wire is wound, and pole-pieces. Its elliptical flanges support the binding-screws, the contact screw, the armature and the cover, while the lower extremity supports the bell.

516. "Improvements connected with points and switches on electric tramways and railways." J. Vesely. Dated January 5th, 1900. Points and switches, operating from vehicles on electric railways and tramways. Inside the signal post are two electro-magnets, either of which can be excited from the vehicle, through the circuits shown in the dotted lines, by means of the plug switch, when the contacts on the roof and the contacts carried by the trolley pole come into contact with the fixed contacts and the additional contacts by the sides of the trolley wires. The armatures of the magnets consist of sliding rings connected in pairs respectively to arms on opposite sides of the rock shaft, and this shaft operates the point tongues by means of the weighted arm and rod. A toothed sector attached to the rock shaft may also operate the spindle of a disc signal, or other signals may be used.

547. "Improvements in process of and apparatus for magnetic separation." C. A. Payne. Dated January 9th, 1900. Means are provided for controlling the position and direction of the lines of force in the field, and for changing or producing undulations of flux in the field.

559. "Improvements in transformers." W. L. Wise. (Aktiengesellschaft Elektricitatswerke vorm. O. L. Kummer & Co., Germany.) Dated January 9th, 1900. Transformers for feeding a three-wire system from a two-wire supply. The cores have an intermediate cross-connecting piece which prevents loss when the load is unequally divided.

610. "Improvements in electric order telegraphs for use on ship board and elsewhere." C. F. Kronheimer. Dated January 10th, 1900. Relates to electric order telegraphs for use on ship board, or in offices, mines, workshops, fire stations, &c.

622. "Improvements in incandescent arc and other lamps." E. Bonhivers. Dated January 10th, 1900. Refractory blocks, to be rendered incandescent in arc, gas, petroleum, or spirit lamps, are made from a mixture of 25 parts of crude clay, 20 of baked clay, 25 of pounded quartz, and 5 of boric acid. The mixture is heated to a high temperature for 48 hours in a mould made of refractory material, afterwards immersed in a saturated solution of boric acid in water, and dried.

630. "A method of and apparatus for connecting electric meters in three-wire circuits." J. R. Dick and Reason Manufacturing Company. Dated January 10th, 1900. In order to use a single ordinary meter to measure the sum of the currents or energy used on both sides of a three-wire system, the two sides beyond the meter are separated as independent two-wire circuits, the two inner wires being connected through low equal resistances to the neutral main. The meter is connected between the separate ends of the two resistances and under these conditions carries a current proportional to the sum of the currents supplied. The meter may be a maximum demand indicator.

655. "Improvements in electrically actuated mechanism applicable for various purposes, such as the steering of ships, the working of engine room or like telegraphs, or the training of guns." G. E. Vaughan. (J. A. Vaughan, H.M.S. "Monarch.") Dated January 11th, 1900. The invention is shown diagrammatically as a steering gear, but is applicable to other purposes, such as engine room telegraphs and training gear for ordnance.

729. "Improvements in electrical switches and cut-outs." C. H. Dorman, R. A. Smith and H. G. Baggs. Dated January 12th, 1900. The object is to increase the pressure on the contacts when the switch is on and to diminish it prior to the movement to the off position.